Object Types

Reference

Mode:: Object Mode
Menu:: *Add*
Shortcut:: `Shift-A`

New objects can be created with the *Add* menu in the 3D Viewport's header.

Mesh

Objects composed of vertices, edges and polygonal faces and can be edited extensively with Blender's mesh editing tools. See Mesh Primitives.

Curve

Mathematically defined objects which can be manipulated with control handles or control points (instead of vertices), to edit their length and curvature. See Curves Primitives.

Surface

Mathematically defined patches that are manipulated with control points. These are useful for simple rounded forms and organic landscapes. See Surfaces Primitives.

Metaball

Objects formed by a mathematical function (with no vertices or control points) defining the 3D volume in which the object exists. Meta objects have a liquid-like quality where when two or more metaballs are brought together, they merge by smoothly rounding out the connection, appearing as one unified object. See Meta Primitives.

Text

Create a two-dimensional representation of a text.

Volume

Container for OpenVDB files that is generated by other software or Blender's Fluid Simulator.

Grease Pencil

Objects created by drawing strokes. See Grease Pencil Primitives

Armature

Used for rigging 3D models to make them pose-able and animatable.

Lattice

Non-renderable wireframes commonly used for the deformation of other objects with help of the Lattice Modifier.

Empty

Null objects that are simple visual transform nodes that do not render. They are useful for controlling the position or movement of other objects.

Image

Empty objects that display images in the 3D Viewport. These images can be used to aid artists in modeling or animating.

Image Plane

Adds a mesh plane with materials and texture from an image file. The dimensions of the plane are calculated to match the aspect of the image file.

Light

Empty objects that emit light and are used for lighting the scene in renders.

Light Probe

Used by the EEVEE render engine to record lighting information for indirect lighting.

Camera

This is the virtual camera that is used to determine what appears in the render.

Speaker
Empty objects that bring a source of sound to the scene.

Force Field
Empty objects that give simulations external forces, creating movement, and are represented in the 3D Viewport as small control objects.

Collection Instance
Lets you select from a list of existing collections. Once selected, an empty object will be created, with an instance of the selected collection (collection instancing active).

Common Options

You can change the options of the object in the Adjust Last Operation panel just after creating it:

Type
You can change the type of some objects after their creation with a selector.

Radius/Size
Sets the starting size.

Align
Rotates the new object so that it is aligned in one of the following manners:

World::	Aligns the object to the global space axes, i.e. the object's front faces the negative Y axis (default).
View::	Aligns the object to the view space axes, i.e. the object's front faces the viewport's point of view.
3D Cursor::	Aligns the object to match the rotation of the 3D Cursor.

Location

Objects are placed, by default, at the position of the 3D Cursor. These values let you place the object in an other position.

Rotation

Values let you rotate the object so that default rotation is overridden.

Object Origin

Each object has an origin point. The location of this point determines where the object is located in 3D space. When an object is selected, a small circle appears, denoting the origin point. The location of the origin point is important when translating, rotating or scaling an object. See Pivot Points for more.

The color of the origin changes based on the selection state of the object.

Yellow::	Object is active.
Orange::	Object is selected, but not active.
White::	Object is not linked and not selected.
Turquoise::	Object is linked.
Light Turquoise::	Object is selected, linked, but not active.

Note

Colors are themeable and might appear different. The colors described here are from the default Dark Theme.

Set Origin

Reference

Mode::	Object Mode
Menu::	*Object ‣ Set Origin*

The object origin and geometry can be moved relative to each other and to the 3D cursor.

Type

Geometry to Origin

Moves the model to the origin and this way the origin of the object will also be at the center of the object.

Origin to Geometry

Moves the origin to the center of the object.

Origin to 3D Cursor

Moves the origin of the model to the position of the 3D cursor.

Origin to Center of Mass

Moves the origin to the calculated center of mass of model (assuming the mesh has a uniform density).

Center

Median Point Center, Bounding Box Center

Tip

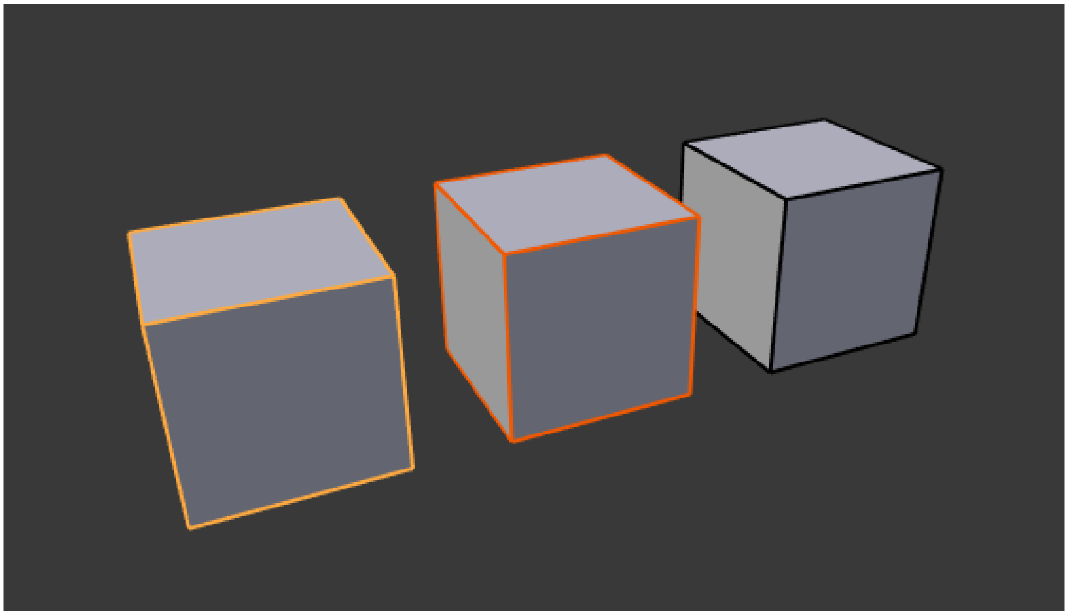
To transform an object’s origin directly, enable Affect Only Origins in the *Tool Settings Options*.

Selecting

Selection determines which elements will be the target of our actions. Selections work on the current scene visible objects. Blender has advanced selection methods. Both in *Object Mode* and in *Edit Mode*.

Selections and the Active Object

Blender distinguishes between two different states of selection:



Active object in yellow, selected object in orange, and unselected object in black.

In *Object Mode* the last (de)selected item is called the "Active Object" and is outlined in yellow (the others are orange). There is at most one active object at any time.

Many actions in Blender use the active object as a reference (for example linking operations). If you already have a selection and need to make a different object the active one, simply reselect it with `Shift-LMB`.

All other selected objects are just selected. You can select any number of objects. In order to change a property or to perform an operation on all selected objects (bones, and sequencer strips) hold `Alt`, while confirming.

Select Menu

All

Reference

Mode::	All Modes
Menu::	*Select ▸ All*
Shortcut::	`A`

Select all selectable objects.

None

Reference

Mode::	All Modes
Menu::	*Select ▸ None*
Shortcut::	`Alt-A`

Deselect all objects, but the active object stays the same.

Invert

Reference

Mode::	All Modes
Menu::	*Select ▸ Invert*
Shortcut::	`Ctrl-I`

Toggle the selection state of all visible objects.

Box Select

Reference

Mode::	All Modes
Menu::	*Select ‣ Box Select*
Shortcut::	`B`

Interactive box selection.

Circle Select

Reference

Mode::	All Modes
Menu::	*Select ‣ Circle Select*
Shortcut::	`C`

Interactive circle selection.

Lasso Select

Reference

Mode::	All modes
Menu::	*Select ‣ Lasso Select*
Shortcut::	`Ctrl-Alt-LMB`

See Select Lasso.

Select Active Camera

Reference

Mode::	Object Mode

Menu:: *Select ‣ Select Active Camera*

Selects the active camera, this is especially handy in complex scene.

Select Mirror

Reference

Mode:: All Modes
Menu:: *Select ‣ Select Mirror*

Select the Mirror objects of the selected object, based on their names, e.g. “sword.L” and “sword.R”.

Select Random

Reference

Mode:: Object Mode
Menu:: *Select ‣ Select Random*

Randomly selects unselected objects based on percentage probability. The percentage can be modified in the *Adjust Last Operation* panel. It is important to note that the percentage is the likelihood of an unselected object being selected and not the percentage amount of objects that will be selected.

Select More/Less

Reference

Mode:: Object Mode
Menu:: *Select ‣ More/Less*
Shortcut:: `Ctrl-NumpadPlus`, `Ctrl-NumpadMinus`

Their purpose, based on the hierarchical.

More
: Expand the selection to the immediate parent and children of the selected objects.

Less
: Contrast the selection, deselect objects at the boundaries of parent/child relationships.

Parent
: Deselects the currently selected objects and selects their immediate parents.

Child
: Deselects the currently selected objects and selects their immediate children.

Extend Parent
: Extends the selection to the immediate parents of the currently selected objects.

Extend Child
: Extends the selection to the immediate children of the currently selected objects.

Select All by Type

Reference

Mode::	Object Mode
Menu::	*Select ‣ Select All by Type*

With this tool, it becomes possible to select objects of a certain type in one go. For a description of all object types see Object Types.

Select Grouped

Reference

Mode::	Object Mode
Menu::	*Select ‣ Select Grouped*
Shortcut::	`Shift-G`

There are two ways to organize the objects in relation to one another. The first one is *parenting*, and the second is simple *grouping*. These relationships to an artist's advantage by selecting members of respective families or groups. *Select Grouped* uses the active object as a basis to select all others.

Children
    Selects all hierarchical descendants of the active object.

Immediate Children
    Selects all direct children of the active object.

Parent
    Selects the parent of this object if it has one.

Siblings
    Select objects that have the same parent as the active object. This can also be used to select all root level objects (objects with no parents).

Type
    Select objects that are the same type as the active one.

Collection
    Select all objects that are in the same collection as the active one. If the active object belongs to more than one collection, a list will pop up so that you can choose which collection to select.

Object Hooks
    Every hook that belongs to the active object.

Pass
    Select objects assigned to the same Render Pass.

Color
Select objects with same Object Color.

Keying Set
Select objects included in the active Keying Set.

Light Type
Select matching light types.

Select Linked

Reference

Mode::	Object Mode
Menu::	*Select* ‣ *Select Linked*
Shortcut::	`Shift-L`

Selects all objects which share a common data-block with the active object. *Select Linked* uses the active object as a basis to select all others.

Object Data
Selects every object that is linked to the same Object Data, i.e. the data-block that specifies the type (mesh, curve, etc.) and the build (constitutive elements like vertices, control vertices, and where they are in space) of the object.

Material
Selects every object that is linked to the same material data-block.

Instanced Collection
Select every object that is linked to the instanced collection.

Texture
Selects every object that is linked to the same texture data-block.

Particle System
Selects all objects that use the same *Particle System*.

Library

Selects all objects that are in the same Library.

Library (Object Data)

Selects all objects that are in the same Library and limited to *Object Data*.

Select Pattern

Reference

Mode:: Object Mode

Menu:: *Select ‣ Select Pattern…*

Selects all elements whose name matches a given pattern. Supported wildcards: * matches everything, `?` matches any single character, `[abc]` matches characters in `abc`, and `[!abc]` match any character not in `abc`. As an example `*house*` matches any name that contains `house`, while `floor*` matches any name starting with `floor`.

Case Sensitive

The matching can be chosen to be case sensitive or not.

Extend

When *Extend* checkbox is checked the selection is extended instead of generating a new one.

Editing

- Transform
  - Introduction
  - Transform Control
  - Move
  - Rotate
  - Scale
  - Move/Scale Texture Space
  - Align to Transform Orientation
  - Randomize
  - Align Objects
- Mirror
- Clear
- Apply
- Snap
- Duplicate
- Duplicate Linked
- Join
- Asset
- Parenting Objects
- Modifiers
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- Relations
  - Make Single User
- Link/Transfer Data
  - Link Objects to Scene
  - Link Data
  - Copy UV Maps
  - Transfer Mesh Data
  - Transfer Mesh Data Layout
- Shading
- Rigid Body
- Convert

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Transform

- Introduction
- Transform Control
  - Numeric Input
  - Axis Locking
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Introduction

Transformations refer to a number of operations that can be performed on a selected Object or Mesh that alters its position or characteristics.

Each object can be moved, rotated and scaled in *Object Mode*. However, not all of these transformations have an effect on all objects. For example, scaling a camera has no effect on the render dimensions.

Basic transformations include:

- Move
- Rotate
- Scale

These three transforms are the three big ones. However, more advanced transformations can be found in the Advanced Transformations section.

For making other changes to the geometry of editable objects, you should use *Edit Mode*.

Once you have added a basic object, you remain in *Object Mode*. You can switch between *Object Mode* and *Edit Mode* by pressing `Tab`. The object’s wireframe should now appear orange. This means that the object is now selected and active.

Transform Control

Transform controls can be used to modify and control the effects of the available transformations.

- Numeric Input
    - Simple Mode
    - Advanced Mode
- Axis Locking
    - Usage
    - Axis Locking Types
- Precision
    - Usage
    - Snapping
    - Precision

Numeric Input

Using the mouse for transformations is convenient, but if you require more precise control, you can also enter numeric values. After pressing the shortcut type a number to indicate the magnitude of the transformation. Then confirm or cancel. E.g. pressing `S 2`, `Return` will double the scale of an object.

Move `G`

> By default and with no other key presses, the translation will occur along the X axis.

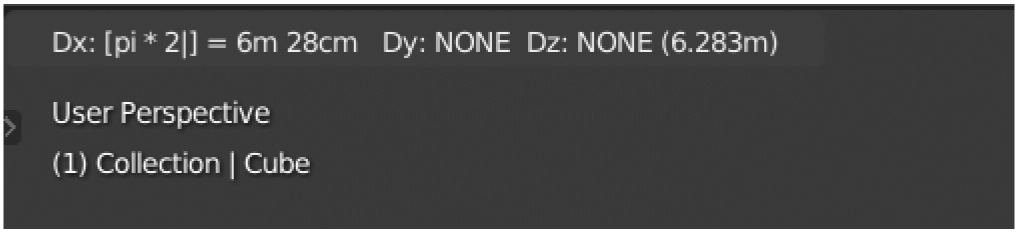
Rotation `R`

> The rotation is in clockwise direction for positive values.

Scale `S`

> Scaling works in almost identical fashion to translation. The primary difference is that by default, scaling applies equally to all three axes.

You can see the numbers you enter in the 3D Viewport footer.



```
Dx: [pi * 2|] = 6m 28cm   Dy: NONE  Dz: NONE (6.283m)

User Perspective
(1) Collection | Cube
```

Numeric input displayed in the footer.

Tip

Numeric input can also be inputted in the Properties region.

Simple Mode

Blender has two “modes” a simple and an advanced one. Simple mode only accepts simple numbers. You can use basic text editing except selection.

Decimals `Period`
Decimals can be entered by pressing `Period`.

Negate `Minus`
Negate the whole value by pressing `Minus`.

Inverse `Slash`
Hitting `Slash` during number entry switches the number being entered to its reciprocal, e.g. `2 /` results in 0.5 (1/2); `20 /` results in 0.05 (1/20).

Reset `Backspace`
Hitting `Backspace` after having deleted all leading chars will first reset the edited value to initial state, and on second press, the whole number editing will be canceled, going back to usual transform with mouse.

Next/Previous Component `Tab`, `Ctrl-Tab`
To enter numeric values for multiple axes, use `Tab` or `Ctrl-Tab`. E.g. To move an object, one unit on all three axes press: `G 1` and `Tab 1` and `Tab 1`.

Non-number Inputs
You can also combine numeric input with Axis Locking to limit movement to a particular axis or tool specific shortcuts.

Advanced Mode

In advanced mode you can additionally enter expressions and units.

Use `=` or `NumpadAsterisk` to enable advanced mode, and `Ctrl-=` or `Ctrl-NumpadAsterisk` to switch back to simple mode.

It features:

- Units (`cm`, `"`, `deg`, etc.). See unit system.
- Basic operations from Python (`+`, `*`, `/`, `**`, etc.).

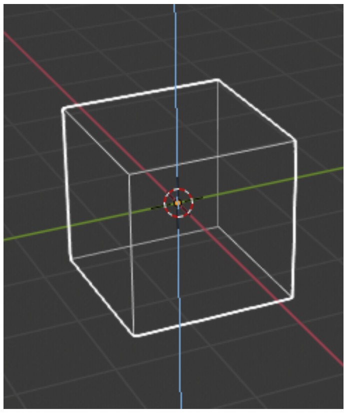
- Math constants and functions (`pi`, `sin`, `sqrt`, etc.). See Python's math module.

You can still use the negate and inverse shortcuts (`Minus`, `Slash`), as well as non-number inputs, but you have to hold `Ctrl` to activate them.

Axis Locking

This option limits the transformation to the specified axis.

Transformations (translation/scale/rotation) in *Object Mode* and *Edit Mode* (as well as extrusions in *Edit Mode*) can be locked to a particular axis relative to the current transform orientation. By locking a transformation to a particular axis you are restricting transformations to a single dimension.



Axis locking.

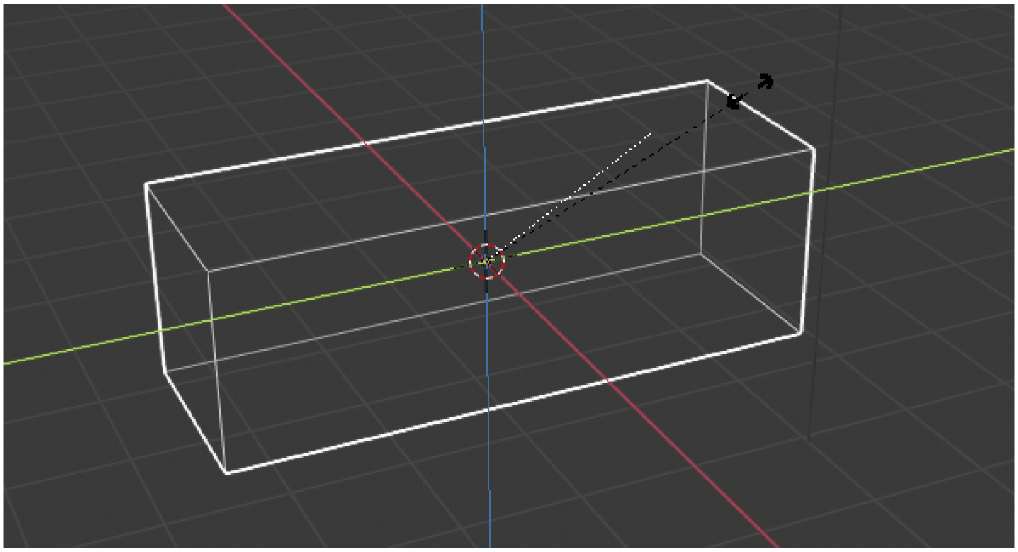
Usage

A locked axis will display in a brighter color than an unlocked axis. For example in the image to the right, the Z axis is shown in light blue as movement is constrained to this axis. This example, can be achieved in two ways:

Hotkey

The axis of movement can be changed at any time during transformation by typing `X`, `Y`, `Z`.

Pointing



Axis constraint in action.

Holding `MMB` after starting a transformation lets you select an axis to constrain to. A visual option to constrain the translation will be available, showing the three axes in the 3D Viewport space. A dotted white line is used as a pointer. The axis of choice to confirm the operation will depend on the highlighted axis about which the `MMB` is released.

When you already moved the mouse in the desired direction, pressing `MMB` will lock to the axis which was pointed at.

Axis Locking Types

Axis Locking

Reference

Mode::	Object and Edit Modes (move, rotate, scale, extrude)
Shortcut::	`X`, `Y`, `Z` or `MMB` after moving the mouse in the desired direction.

Axis locking limits the transformation to a single axis (or forbids transformations along two axes). An object, face, vertex or other selectable item will only be able to move, scale or rotate in a single dimension.

Plane Locking

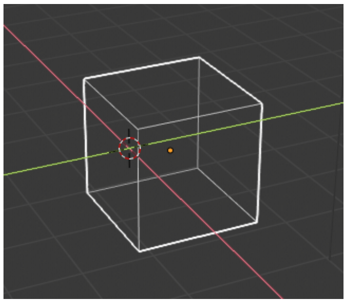
Reference

Mode::	Object and Edit Modes (move, scale)

Shortcut:: `Shift-X`, `Shift-Y`, `Shift-Z` or `Shift-MMB` after moving the mouse in the desired direction.

Plane locking locks the transformation to *two* axes (or forbids transformations along one axis), thus creating a plane in which the element can be moved or scaled freely. Plane locking only affects translation and scaling.

Note that for rotation, both axis and plane locking have the same effect because a rotation is always constrained around one axis. *Trackball* type rotations `R R` cannot be locked at all.



Plane locking.

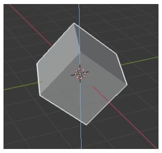
Axis Locking Modes

A single key press constrains movement to the current transform orientation selection. A second key press of the *same* key constrains movement to the corresponding *Global* axis (except if the transform orientation is set to *Global*, in which case the *Local* orientation is used). A third key press of the same key removes constraints.

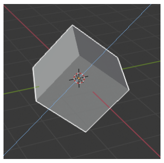
The orientation can be set in the Transform Orientation selector of the 3D Viewport header.

For example, if the current transform orientation is set to *Normal*, pressing `G` to start translation, followed by `Z` will lock translation in the Z direction relative to the *Normal* orientation, pressing `Z` again will lock translation to the Z axis relative to the *Global* orientation. Pressing `Z` again will remove all constraints. The current mode will be displayed in the left-hand side of the 3D Viewport header.

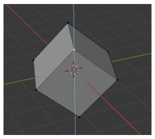
Axis locking modes.



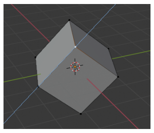
Z axis locking in Global orientation.



Z axis locking in Local orientation.



Z axis locking in Global orientation with vertex selection.



Z axis locking in Normal orientation with vertex selection.

As can be seen in the *Axis locking modes* image, the direction of the transform also takes into account the selection.

Note that using a locked axis does not prevent you from using the keyboard to enter numeric transformation values.

Precision

Reference

Mode:: Object and Edit Modes
Shortcut:: `Ctrl` and/or `Shift`

Holding `Ctrl` during a transform operation (such as move, rotate or scale) will toggle Transform Snapping. When using Increment Snap this allows the transformation to be performed in discrete amounts.

Holding `Shift` during a transform operation will transform the object at 1/10th the speed, allowing much finer control.

The magnitude of the transformation can be viewed in the 3D Viewport header. Releasing `Ctrl` or `Shift` during the transformation will cause the movement to revert back to its normal mode of operation.

Note

The snapping behaviors described on this page **only** apply when Increment Snap is selected.

Tip

It is possible to enable both snapping and precision mode, simply hold `Ctrl` and `Shift`. This has the following effects:

Move
Changes in 0.1 unit increments, regardless of zoom level.

Rotation
Changes in 1 unit increments.

Scale

Changes in 0.01 unit increments.

Usage

With Hotkeys

Press `G`, `R` or `S` and then hold either `Ctrl`, `Shift` or `Shift-Ctrl`.

With the Transform Gizmo

Select the gizmo handle then while moving the mouse hold `Ctrl`, `Shift` or `Shift-Ctrl` to activate precision control or snapping.

See also

Read more about the Transform Gizmo.

Tip

Combining with Other Controls

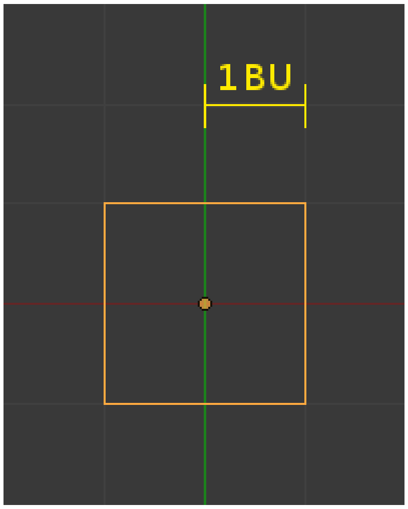
All of the precision controls detailed on the page can be combined with the Axis Locking controls and used with the different Pivot Points.

Snapping

Move

Snapping while moving objects changes the object location in 1 unit increments. While in an aligned view, The increment amount is changed based on the zoom level. For example, at a base zoom level objects are moved in increments of 1 unit (i.e. between the two light gray lines).

Zooming in enough to see the next set of gray lines will snap in increments of 1/10 of a unit. Zooming in further until will snap in increments of 1/100 of a unit and so on until the zoom limit is reached. Zooming out will have the opposite effect and cause movement to happen by increments of 10, 100 units, etc.



One unit (default zoom level).

Rotation

Holding `Ctrl` will cause rotations of 5 degrees.

Scale

Holding `Ctrl` will cause size changes in increments of 0.1 units.

Note

Snapping Modes

Note that when you are Snapping To something other than *Increment*, holding `Ctrl` will cause the selection to snap to that nearest element.

Read more about snapping.

Precision

Holding `Shift` during transformations allows for very fine control that does not rely on fixed increments. Rather, large movements of the mouse across the screen only result in small transformations of the selection.

In rotation mode the selected element will be rotate in 0.01 degree increments.

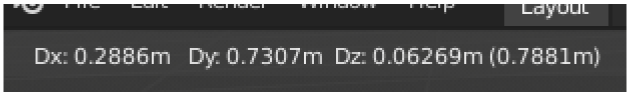
Move

Reference

Mode:: Object Mode, Edit Mode, and Pose Mode
Menu:: *Object/Mesh/Curve/Surface* ▸ *Transform* ▸ *Move*
Shortcut:: `G`

In Object Mode, the move option lets you move objects. Translation means changing location of objects. It also lets you move any elements that make up the object within the 3D space of the active 3D Viewport.

Pressing `G` activates “Move” transformation mode. The selected object or element then moves freely according to the mouse pointer’s location and camera. To confirm the action, press `LMB`. While moving items, the amount of change along the X, Y, and Z axis is displayed in the header of the 3D Viewport.



Dx: 0.2886m Dy: 0.7307m Dz: 0.06269m (0.7881m)

Translation Display.

Tip

Moving an object in Object Mode changes the object’s origin. Moving the object’s vertices/edges/faces in Edit Mode does not change the object’s origin.

See also

Using a combination of shortcuts gives you more control over your transformation. See Transform Control.

Options

Move X, Y, Z
  The amount to move the selection on the respected axis.

Orientation
  Aligns the transformation axes to a specified orientation constraint. See Transform Orientations for more information.

Proportional Editing
  The extruded face will affect nearby geometry. See Proportional Editing for a full reference.

Rotate

Reference

Mode::	Object and Edit Modes
Menu::	*Object/Mesh/Curve/Surface* ‣ *Transform* ‣ *Rotate*
Shortcut::	R

Rotation is also known as a spin, twist, orbit, pivot, revolve, or roll and involves changing the orientation of elements (vertices, edges, faces, objects, etc.) around one or more axes or the Pivot Point.

The angle of rotation is displayed in the header of the 3D Viewport.

Rot: 69.95

Rotation values.

See also

Using a combination of shortcuts gives you more control over your transformation. See Transform Control.

Options

Angle

The amount of rotation.

Axis

Used to constraint the transformation to one or more axes.

Orientation

Aligns the transformation axes to a specified orientation constraint. See Transform Orientations for more information.

Proportional Editing

The extruded face will affect nearby geometry. See Proportional Editing for a full reference.

Trackball Rotation

Reference

Mode::	Object and Edit Modes
Shortcut::	`R R`

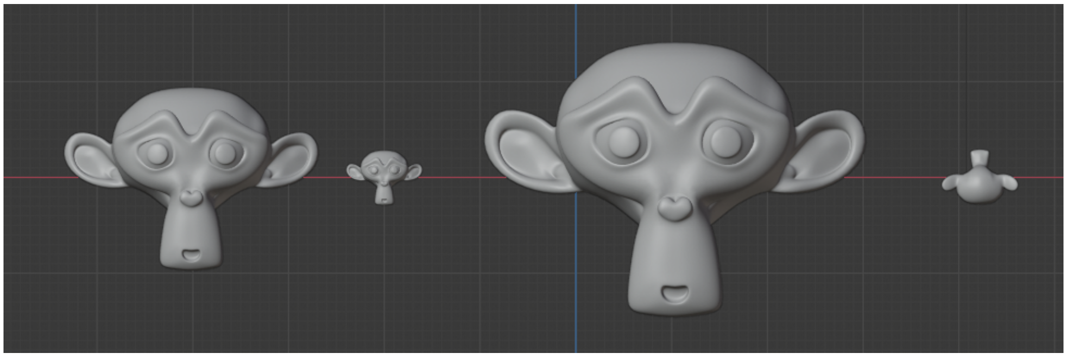
A free rotation mode. Press `R R` to enable Trackball rotation.

Scale

Reference

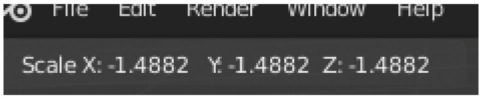
Mode::	Object and Edit Modes
Menu::	*Object/Mesh/Curve/Surface* ▸ *Transform* ▸ *Scale*
Shortcut::	`S`

Scaling means changing proportions of objects. Pressing `S` will enter the *Scale* transformation mode where the selected element is scaled inward or outward according to the mouse pointer's location. The element's scale will increase as the mouse pointer is moved away from the Pivot Point and decrease as the pointer is moved towards it. If the mouse pointer crosses from the original side of the [Pivot Point](#) to the opposite side, the scale will continue in the negative direction and flip the element.



Basic scale usage. From left to right, the panels show: the original object, a scaled down object, a scaled up object and a scale-flipped object.

The amount of scaling will be displayed in the header of the 3D Viewport.



Scale X: -1.4882 Y: -1.4882 Z: -1.4882

Scale values.

See also

Using a combination of shortcuts gives you more control over your transformation. See Transform Control.

Options

Scale X, Y, Z
The amount to resize the selection on the respected axis.

Orientation
Aligns the transformation axes to a specified orientation constraint. See Transform Orientations for more information.

Proportional Editing
The extruded face will affect nearby geometry. See Proportional Editing for a full reference.

Move/Scale Texture Space

Reference

Mode:: Object Mode and Edit Mode
Menu:: *Object ‣ Transform ‣ Move/Scale Texture Space*

The Move/Scale Texture Space tool transforms the Texture Space of the object, instead of the object or element itself.

Align to Transform Orientation

Reference

Mode:: Object Mode and Edit Mode
Menu:: *Object ‣ Transform ‣ Align to Transform Orientation*

Aligns (rotates) the selected objects so that their local orientation matches the active transform orientation in the Transform orientation panel or the *Orientation* selection in the Transform Adjust Last Operation panels.

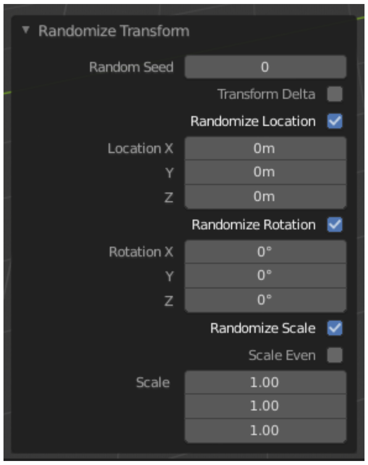
Randomize

Reference

Mode:: Object Mode and Edit Mode

Menu:: *Object ‣ Transform ‣ Randomize Transform*

This tool randomizes the move, rotate, and scale values to an object or multiple objects. When applied on multiple objects, each object gets its own seed value, and will get different transform results from the rest.



▾ Randomize Transform
Random Seed 0
Transform Delta ☐
Randomize Location ☑
Location X 0m
Y 0m
Z 0m
Randomize Rotation ☑
Rotation X 0°
Y 0°
Z 0°
Randomize Scale ☑
Scale Even ☐
Scale 1.00
1.00
1.00

Randomize transform options.

Random Seed

The random seed is an offset to the randomized transformation. A different seed will produce a new result.

Transform Delta

Randomize Delta Transform values instead of regular transform.

Randomize Location

Randomize Location values.

Location

The maximum distances the objects can move along each axis.

Randomize Rotation

Randomize rotation values.

Rotation

The maximum angle the objects can rotate on each axis.

Randomize Scale

Randomize scale values.

Scale Even

Use the same scale for each axis.

Scale

The maximum scale randomization over each axis.

Align Objects

Reference

Mode::	Object Mode
Menu::	*Object ‣ Transform ‣ Align Objects*

The Align tool is used to align multiple selected objects so they line up on a specified axis.

Options

High Quality

Uses more precise math to better determine the locations for the objects. In case of positive or negative bounding box alignment, if one or more of the selected objects have any rotation transformations (or delta rotation transformations), it is recommended to check *High Quality* so that their bounding box is calculated with precision for all three global axes.

Align Mode

The *Align Mode* control will define what part of the objects will be aligned:

Centers::	The objects centers.
Positive Sides/Negative Sides::	The positive or negative sides (on the global axes) of their respective bounding boxes.

Relative To

The *Relative To* control will let us choose to align the objects to:

Active::	The active object.
Selection::	The median point of the selection.

3D Cursor:: The current position of the 3D Cursor.

Scene Origin:: The global origin.

Align X, Y, Z

Chooses which axis to align the selected objects on.

Mirror

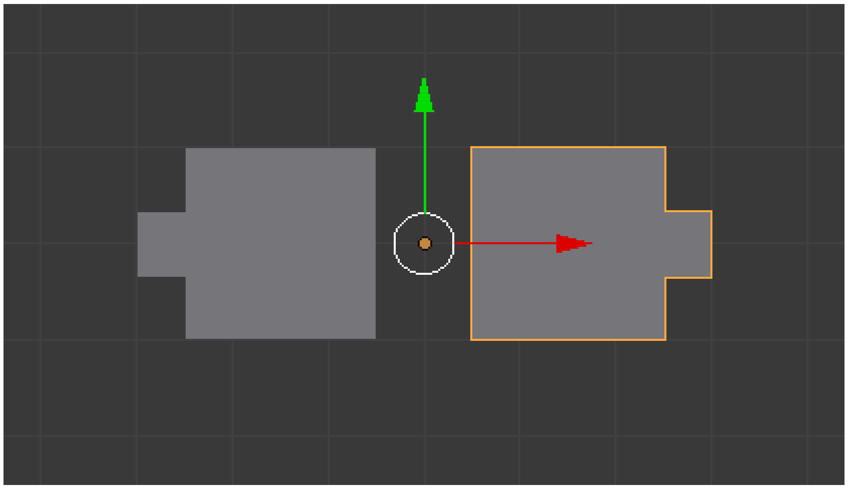
Reference

Mode::	Object and Edit Modes
Menu::	*Object/Mesh* ‣ *Mirror*
Shortcut::	`Ctrl-M`

Mirroring an object or mesh selection will create a reversed version of the selection. The position of the mirrored version of the selection is determined by the Pivot Point. A common use of mirroring is to model half an object, duplicate it and then use the mirror transform to create a reversed version to complete the model.

Note

Mirrored duplicates can also be created with a Mirror Modifier.

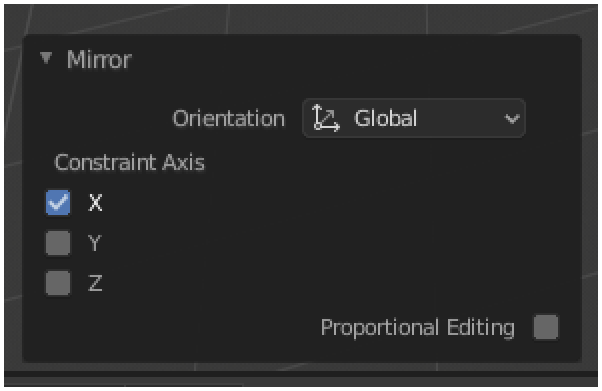


Mirroring a selection.

Usage

To mirror a selection along a particular global axis, press: `Ctrl-M`, followed by `X`, `Y` or `Z`. The image Mirroring a Selection shows the results of this action after a mesh element has been duplicated.

In mesh mode, you can mirror the selection on the currently selected Transform Orientations by pressing the appropriate axis key a second time. For example, if the Transform Orientation is set to *Normal*, pressing: `Ctrl-M`, followed by `X` and then `X` again will mirror the selection along the X axis of the *Normal Orientation*.



Mirror

Orientation: Global

Constraint Axis

☑ X

☐ Y

☐ Z

Proportional Editing ☐

Mirror Adjust Last Operation panel.

You can alternatively hold the `MMB` to interactively mirror the object by moving the mouse in the direction of the mirror axis.

Clear

Reference

Mode::	Object Mode
Menu::	*Object ‣ Clear ‣ Location / Scale / Rotation / Origin*
Shortcut::	`Alt-G`, `Alt-S`, `Alt-R`

Clearing transforms resets the transform values. The objects location and rotation values are set to 0, and the scale to 1.

Clear Location `Alt-G`
  Clear (reset) the location of the selection. This will move the selection back to the coordinates (0, 0, 0).

Clear Scale `Alt-S`
  Clear (reset) the scale of the selection. This will change the scale to (1, 1, 1).

Clear Rotation `Alt-R`
  Clear (reset) the rotation of the selection. This will set the rotation of the selection to 0 degrees in each plane.

Clear Origin
  Clears (resets) the offset of the child objects origin from the Parent. This will cause child objects to move to the origin of the parent. The relationship between the parent and child is not affected, you can confirm the relationship is still intact by using the *Outliner* to verify that the child object is still parented.

Options

Clear Delta

Clear the delta transform in addition to clearing the primary transforms. (Appears in the Adjust Last Operation panel.)

Apply

These operations lets you apply several transformations to the selected objects. The object transformation coordinates are transferred to the object data. If the objects have hierarchical descendants, it also applies those transformations to their children.

Transforms

Reference

Mode::	Object Mode
Menu::	*Object ‣ Apply ‣ Location / Rotation / Scale / Rotation & Scale*
Shortcut::	`Ctrl-A`

Applying transform values essentially resets the values of object's location, rotation or scale, while visually keeping the object data in-place. The object origin point is moved to the global origin, the rotation is cleared and scale values are set to 1.

For simple cases you won't notice any difference the 3D Viewport or rendered output, yet modifiers and constraints may depend on object transformation.

Warning

Armature Objects

While applying transformations to armatures is supported, this does **not** apply to their pose location, animation curves or constraints. This tool should be used before rigging and animation.

When applying transforms to an object that shares Object Data between multiple objects, the object must first be made a Single User which can be performed by confirming the pop-up message.

When running *Apply Transform*, the Adjust Last Operation panel lets you choose the combination of transformations to apply.

Options

Location

Apply (set) the location of the selection. This will make Blender consider the current location to be equivalent to 0 in each plane i.e. the selection will not move, the current location will be considered to be the "default location". The object origin will be set to actual (0, 0, 0) (where the colored axis lines intersect in each view).

Rotation

Apply (set) the rotation of the selection. This will make Blender consider the current rotation to be equivalent to 0 degrees in each plane i.e. the selection will not rotated, the current rotation will be considered to be the "default rotation".

Scale

Apply (set) the scale of the selection. This will make Blender consider the current scale to be equivalent to 0 in each plane i.e. the selection will not scaled, the current scale will be considered to be the "default scale".

Rotation and Scale

Apply (set) the rotation and scale of the selection. Do the above two applications simultaneously.

Apply Properties

Modify properties such as curve vertex radius, font size and bone envelope according to the applied transformation. (Found in the Adjust Last Operation panel)

Transforms to Deltas

Reference

Mode::	Object Mode
Menu::	*Object ‣ Apply ‣ Location / Rotation / Scale to Deltas*
Shortcut::	`Ctrl-A`

Converts primary object transformations to delta transforms, any existing delta transforms will be included as well.

- Location to Deltas
- Rotation to Deltas
- Scale to Deltas

All Transforms to Deltas
Converts all primary transformations to delta transforms.

Animated Transform to Deltas
Converts the primary transformation animations (of the translation, scale, and, rotation values) to delta transforms.

Options

Reset Values
Clear primary transform values after transferring to deltas.

Visual Transform

Reference

Mode::	Object Mode
Menu::	*Object ‣ Apply ‣ Visual Transform*
Shortcut::	`Ctrl-A`

Apply (set) the result of a constraint and apply this back to the object's location, rotation and scale.

Visual Geometry as Mesh

Reference

Mode:: Object Mode
Menu:: *Object ‣ Apply ‣ Visual Geometry to Mesh*
Shortcut:: `Ctrl-A`

Apply the visual state of all selected objects (modifiers, shape keys, hooks, etc.) to object data. This is a way to freeze all object data into static meshes, as well as converts non-mesh types to mesh.

For details, see the Convert mesh.

Make Instances Real

Reference

Mode:: Object Mode
Menu:: *Object ‣ Apply ‣ Make Instances Real*

Make Instances Real creates a new object for each instance generated by the selected ones, and removes any direct instancing from those.

In the end, each instance becomes a real object.

Warning

This applies to both direct (from verts or faces…) and indirect (from particle system…) instancing. In case you have tens of thousands of instances (from particles for example), this can significantly slow down

Blender, which does not always deal well with that many objects in a scene.

Options

By default, new objects will be added to the same collection as the one containing their instancer, without keeping any hierarchy relationships. This behavior can be altered with the following options.

Parent

If *Keep Hierarchy* is not set, parents all the generated objects to the former instancer.

Otherwise, parents all the generated objects *which are not already parented* to their respective instancer, or its matching new copy (this is important in case of recursive instancing, see the note below).

Keep Hierarchy

Preserves internal hierarchies (i.e. parent relationships) in the newly generated objects.

Tip

Usually, to get a new hierarchy as close as possible from the instancing one, you’ll want to enable both of these options.

Note

Preserving relationships in recursive instancing cases (instancers instancing other instancer objects, etc.) is only supported to some extent currently.

Simple cases (like an empty instancing a collection containing instances of some other collections) will usually work, but more complex cases will fail to fully reproduce the whole instancing hierarchy.

Parent Inverse

Reference

Mode::	Object Mode
Menu::	*Object ‣ Apply ‣ Parent Inverse*

Applies the object's Parent Inverse transform to the object data.

Snap

Reference

Mode::	Object, Edit, and Pose Mode
Menu::	*Object/Object type ‣ Snap*
Shortcut::	`Shift-S`

The *Snap* menu (also available from the 3D header in both *Object Mode* and *Edit Mode Object ‣ Snap* and *Mesh ‣ Snap*). This menu provides a number of options to move the cursor or your selection to a defined point (the cursor, selection or the grid).

Selection to Grid
: Snaps the currently selected object(s) to the nearest grid point.

Selection to Cursor
: Moves each one of the currently selected object(s) to the cursor location.

Selection to Cursor (Offset)
: Places the selection at the position of the 3D cursor. If there are multiple objects selected, they are not moved individually at the cursor position; instead, they are centered around the 3D cursor, maintaining their relative distances.

Selection to Active
: Moves the selection to the origin of the active object.

Cursor to Selected
: Places the cursor to the center of the current selection, unless see below.

Cursor to World Origin
: Places the cursor to the origin of the world (location 0, 0, 0).

Cursor to Grid

Places the cursor to the nearest grid point.

Cursor to Active

Places the cursor to the origin of the *active* (last selected) object.

The *Cursor to Selected* option is also affected by the current Pivot Point. For example:

- With the *Bounding Box Center* pivot point active, the *Cursor to Selected* option will snap the 3D cursor to the center of the bounding box surrounding the objects' origins.
- When the *Median Point* pivot point is selected, *Cursor to Selected* will snap the 3D cursor to the median of the object origins.

Duplicate

Reference

Mode:: Edit and Object Modes
Menu:: *Object ‣ Duplicate Objects*
Shortcut:: `Shift-D`

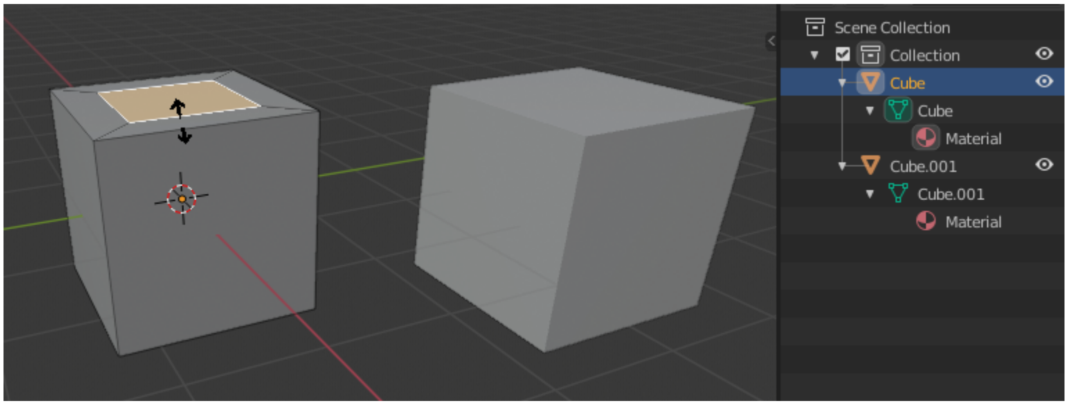
This will create a visually-identical copy of the selected object(s). The copy is created at the same position as the original object and you are automatically placed in move mode. See the examples below.

This copy is a new object, which shares data-blocks with the original object (by default, all the materials, textures, and F-Curves), but which has copied others, like the mesh, for example. That is why this form of duplication is sometimes called “shallow link”, because not all data-blocks are shared; some of them are “hard copied”!

Tip

You can choose which types of data-block will be linked or copied when duplicating in the Preferences.

Examples


Scene Collection
Collection
Cube
Cube
Material
Cube.001
Cube.001
Material

The Cube object was duplicated.

The object `Cube` was duplicated, using `Shift-D`. Both these cubes have separate meshes with unique names: `Cube` and `Cube.001`.

- The original left cube is being edited, the duplicated right cube remains unchanged. The mesh data has been copied, not linked.
- Likewise, if one cube is edited in Object Mode, the other cube remains unchanged. The new object's transform properties or data-block is a copy, not linked.
- When the cube was duplicated, it inherited the material of the original cube. The material properties were linked, not copied.

See above if you want separate copies of the data-blocks normally linked.

Duplicate Linked

Reference

Mode:: Object Mode
Menu:: *Object ▸ Duplicate Linked*
Shortcut:: `Alt-D`

You also have the choice of creating a *Linked Duplicate* rather than a *Duplicate*; this is called a deep link. This will create a new object with **all** of its data linked to the original object. If you modify one of the linked objects in *Edit Mode*, all linked copies are modified. Transform properties (object data-blocks) still remain copies, not links, so you still can rotate, scale, and move freely without affecting the other copies. Reference the Examples for the discussions below.

If the original object was animated, the duplicate will link to the same Action. This means that, even though each object has separate transform properties, they will be set to the same values by the animation system. If this is not desired, make the action a single-user copy in the Action or NLA Editor.

Linked
In the *Duplicate Objects* Adjust Last Operation panel the *Linked* checkbox is checked unlike with *Duplicate*.

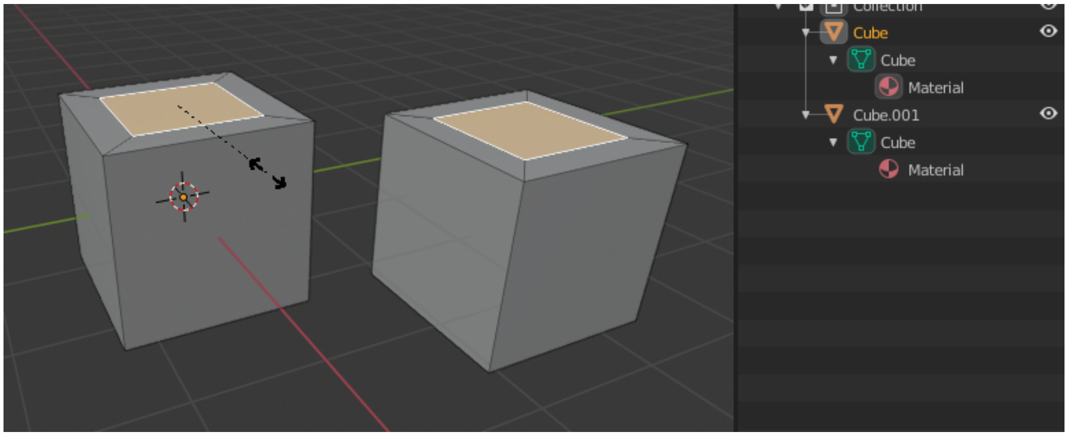
Hint

If you want to make changes to an object in the new linked duplicate independently of the original object, you will have to manually make the object a “single-user” copy by `LMB` the number in the *Object Data* panel of the Properties. (See Data-Block Menu.)

See also

[Make Single User](#) for unlinking data-blocks.

Examples



The Cube object was linked duplicated.

The object `Cube` was linked duplicated, using `Alt-D`. Though both these cubes are separate objects with unique names: `Cube` and `Cube.001`, the single mesh named `Cube`, is shared by both.

- As a mesh is edited in *Edit Mode* in one object, the same occurs in the other cube as well. The mesh data are links, not copies.
- In contrast, if one of these two cubes is rotated or scaled in *Object Mode*, the other remains unchanged. The transform properties are copied, not linked.
- As in the previous example, the newly created cube has inherited the material of the original cube. The material properties are linked, not copied.

A common table has a top and four legs. Model one leg, and then make linked duplicates three times for each of the remaining legs. If you later make a change to the mesh, all the legs will still match. Linked duplicates also apply to a set of drinking glasses, wheels on a car… anywhere there is repetition or symmetry.

See also

Linked Library Duplication

Linked Libraries are also a form of duplication. Any object or data-block in other blend-files can be reused in the current file.

Hint

If you want transform properties (i.e. object data-blocks) to be “linked”, see the page on parenting.

Join

Reference

Mode::	Object Mode
Menu::	*Object ‣ Join*
Shortcut::	`Ctrl-J`

Join merges all selected objects into the last selected *Active* object. All object data is linked to the active object (which must be selected). All objects must be of the same type: mesh, curve, surface or armature. If several curves are joined, each one will keep its subtype (NURBS or Bézier).

Note

Object data has many attributes which may be handled when joining.

Materials, vertex groups, UV and Vertex layers will be merged.

Modifiers, constraints, groups and parent relationships are ignored when joining and will not be applied to the active object.

Asset

Operations for managing the Asset status of an object.

Mark as Asset

See Creating an Asset.

Clear Asset

See Removing Assets.

Clear Asset (Set Fake User)

See Removing Assets.

Parenting Objects

When modeling a complex object, such as a watch, you may choose to model the different parts as separate objects. To make all the parts move as one ("the watch"), you can designate one object as the *parent* of all the other parts. These other parts become its *children*, and any translation, rotation, or scale of the parent will also affects its children.

Contrary to most biological lifeforms, each object or bone in Blender has at most one parent. If an object already has a parent object and you give it another parent then Blender will remove the previous parent relationship. When the plural "parents" is used in this chapter, it references the hierarchy of parents, so the parent, the grandparent, great grandparent, and so on, of an object.

Make Parent

Reference

Mode::	Object Mode
Menu::	*Object* ▸ *Parent*
Shortcut::	`Ctrl-P`

To parent objects, select at least two objects (select the child objects first, and select the parent object last), and press `Ctrl-P`. The *Set Parent To* menu will pop up allowing you to select from one of several possible different parenting types. Selecting one of the entries in *Set Parent To* confirms, and the child/children to parent relationship is created. The selected objects will have their 'parent' set to the active object, and as a result will be 'siblings'.

The *Set Parent To* pop-up menu is context-sensitive, which means the number of entries it displays can change depending on what objects are selected when the `Ctrl-P` shortcut is used.

Moving, rotating or scaling the parent will also usually transform the child/children. Yet transforming the child/children of the parent will not affect the parent. In other words, the direction of influence is from parent to child and not child to parent.

Tip

You can "move" a child object back to its parent by clearing its origin.

Type

Blender supports many different types of parenting, listed below. Besides parenting the selected objects, some types add a Modifier or Constraint to the child objects, with the parent as the target object or activates a parent property i.e. *Follow Path*.

- Object
- Armature Deform
- Bone
- Curve Deform
- Follow Path
- Path Constraint
- Lattice Deform
- Vertex
- Vertex (Triangle)

Keep Transform

The object's current world transform (so its absolute location, rotation and scale in the world) is computed. The new parent is set, and then the *Parent Inverse* matrix is computed such that after setting the new parent the object is still at its previous world transform.

Hint

Use the Outliner

There is another way to see the parent-child relationship in groups and that is to use the *Outliner* view of the Outliner editor.

Parent Inverse

Blender can assign a parent without moving the child object. This is achieved via a hidden matrix called the *Parent Inverse* matrix, which sits between the transform of the parent and the child.

When objects are parented with `Ctrl-P`, Parent Inverse matrix is updated. Depending on the choice in the Set Parent menu, the object's local location, rotation, and scale are also updated. For more details, see Object Parent.

The Parent Inverse matrix can be cleared by using Clear Parent Inverse.

Note

When setting the parent via the Object Properties panel, the Parent Inverse matrix is always reset. This can cause an unexpected jump in the object's position. To avoid this, use `Ctrl-P` to set the new parent.

Object Parent

Object Parent is the most general form of parenting that Blender supports. It will take selected objects and make the active object the parent object of all the selected objects. Each child object will inherit the transformations of the parent. The parent object can be of any type.

If the object has a preexisting parent, that is cleared first. This moves the object to its own location, rotation and scale, without its parent's influence.

There are three operators that allow you to set an object parent. They differ in the way they compute the Parent Inverse matrix and the local Transform of the object.

Example: Object Parent (Keep Transform)

Object Parent with *Keep Transform* will keep any previous transformations applied to them from the previous parent object.

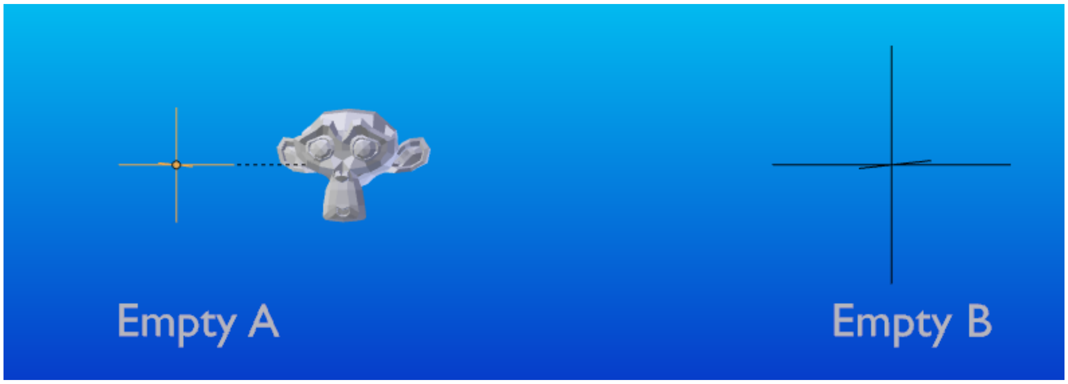
Assume that we have a scene consisting of three objects, those being two empty objects named “EmptyA” and “EmptyB”, and a Monkey object. Fig. Scene with no parenting. shows the three objects with no parenting relationships active on them.

Empty A
Empty B

Scene with no parenting.

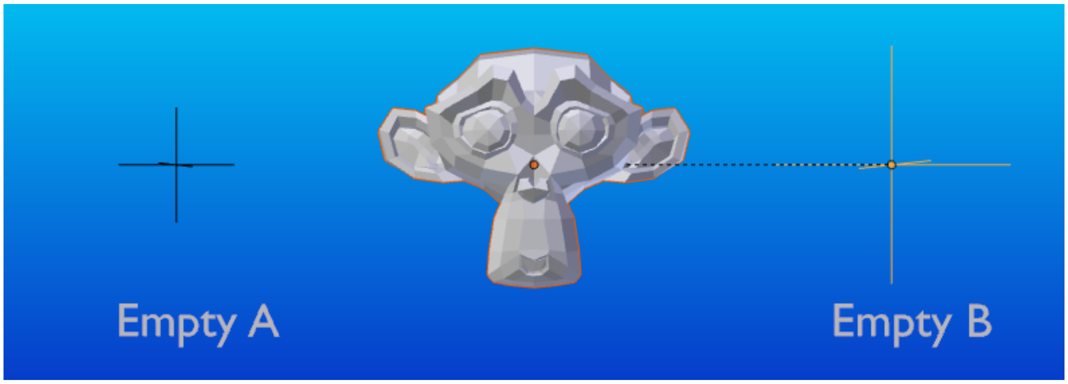
If you select the Monkey object by `LMB` click and then `Shift-LMB` click “EmptyA” object and press `Ctrl-P` and finally select *Object* from the *Set Parent To* pop-up menu. This will result in “EmptyA” object being the parent object of the Monkey object. With only “EmptyA” selected rotating/scaling/moving it will result in the Monkey object being altered respectively.

Scale the “EmptyA” object, so that the Monkey becomes smaller and moves to the left a little.



The monkey is the child object of “EmptyA”.

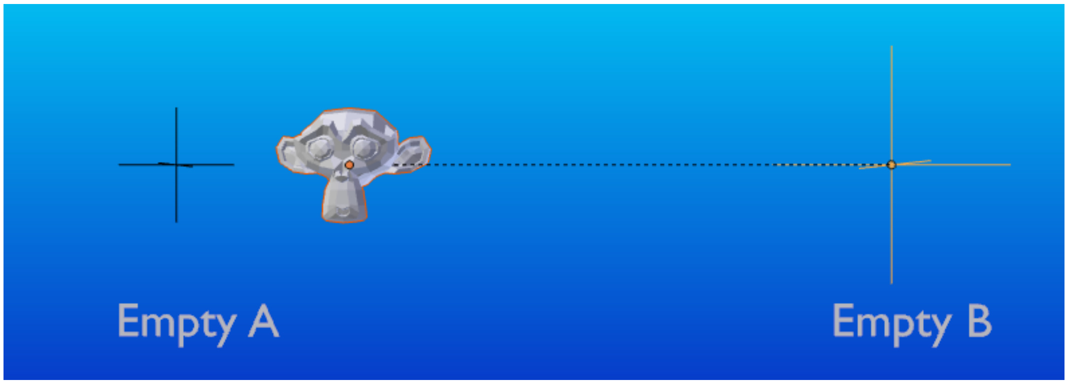
If you select only the Monkey object by `LMB` click and then `Shift-LMB` click “EmptyB” object and press `Ctrl-P` and select *Object* from the *Set Parent To* pop-up menu. This will result in “EmptyB” object being the parent object of the Monkey object. Notice that when you change the parent of the Monkey the scale of the Monkey changed.



The monkey is the child object of “EmptyB”.

This happens because the Monkey object never had its scale altered directly, the change came about because it was the child of “EmptyA” which had its scale altered. Changing the Monkey’s parent to “EmptyB” resulted in those indirect changes in scale being removed, because “EmptyB” has not had its scale altered.

This is often the required behavior, but it is also sometimes useful that if you change your parent object that the child object keep any previous transformations it got from the old parent object; If instead when changing the parent object of the Monkey from “EmptyA” to “EmptyB” we had chosen parenting type *Object* and enable *Keep Transform*, the Monkey would keep its scale information it obtained from the old parent “EmptyA” when it is assigned to the new parent “EmptyB”.



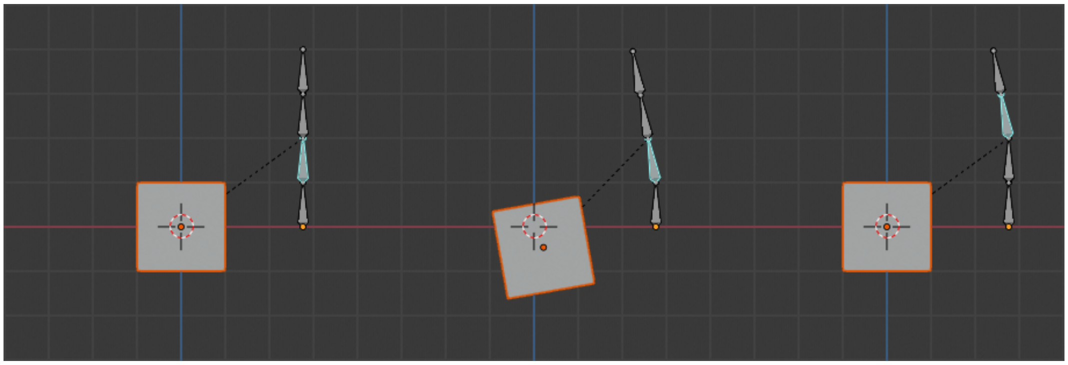
The Object parent with *Keep Transform*.

If you want to follow along with the above description here is the blend-file:

File:Parent_-_Object_(Keep_Transform)_(Demo_File).blend.

Bone Parent

Bone parenting allows you to make a certain bone in an armature the parent object of another object. This means that when transforming an armature the child object will only move if the specific bone is the child object of moves.



Three pictures of armatures with four bones.

In Fig. Three pictures of armatures with four bones. with the 2nd bone being the bone parent of the child object cube. The cube is only transformed if the 1st or 2nd bones are. Notice altering the 3rd and 4th bones has no effect on the cube.

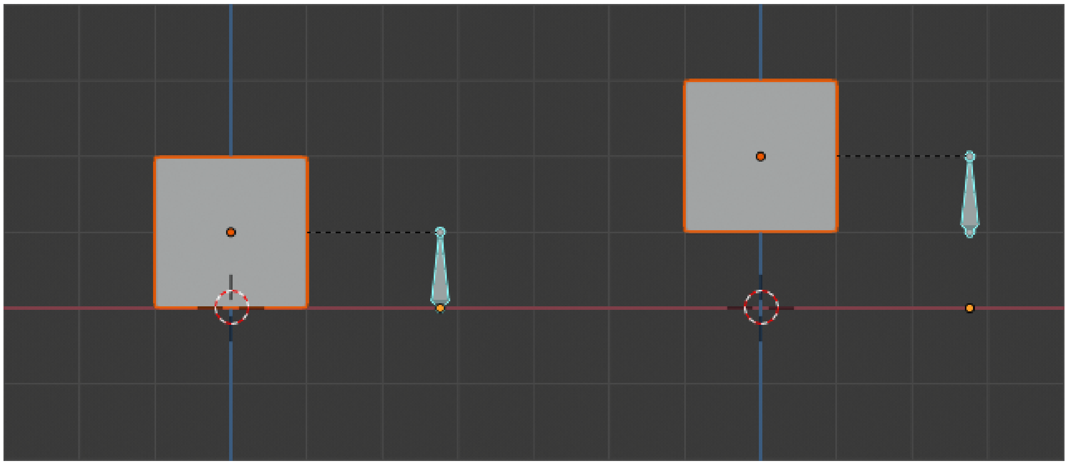
To use bone parenting, you must first select all the child objects you wish to parent to a specific armature bone, then `Shift-LMB` select the armature object and switch it into Pose Mode and then select the specific bone you wish to be the parent bone by `LMB` selecting it. Once done press `Ctrl-P` and select bone from the *Set Parent To* pop-up menu.

Now transforming that bone in Pose Mode will result in the child objects also transforming.

Relative Parenting

Bone relative parenting is an option you can toggle for each bone. This works in the same way as bone parenting with one difference.

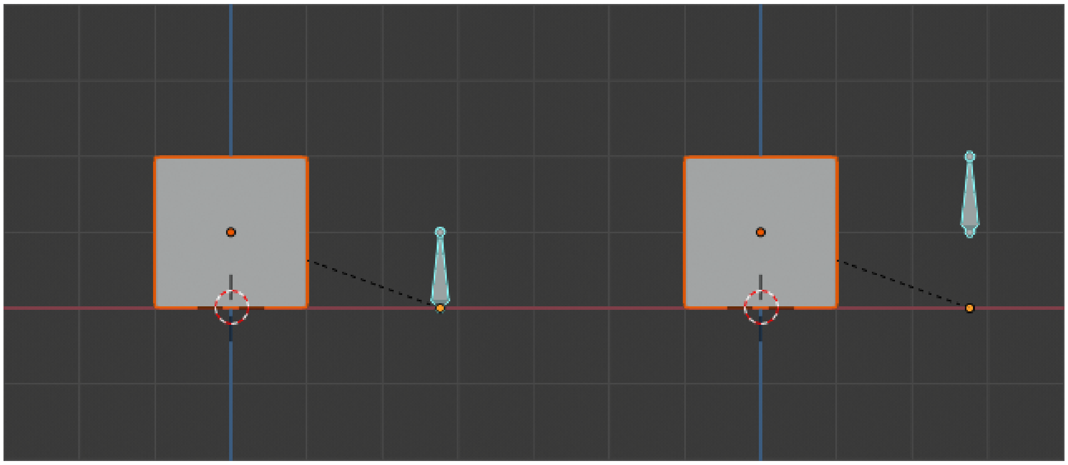
With bone parenting if you have parented a bone to some child objects and you select that bone and switch it into Edit Mode and then move that bone; When you switch back into Pose Mode on that bone, the child object which is parented to that bone will snap back to the location of the bone in Pose Mode.



Single armature bone which has a child object cube parented to it using bone parenting.

In Fig. Single armature bone which has a child object cube parented to it using bone parenting. the 1st picture shows the position of the cube and armature before the bone is moved in Edit Mode. 2nd picture shows the position of the cube and armature after the bone was selected in Edit Mode, moved and switched back into Pose Mode. Notice that the child object moves to the new location of the pose bone.

Bone relative parenting works differently; If you move a parent bone in Edit Mode, when you switch back to Pose Mode, the child objects will not move to the new location of the Pose Bone.



Single bone with bone relative parent to a cube.

In Fig. Single bone with bone relative parent to a cube. the 1st picture shows the position of the cube and armature before the bone is moved in Edit Mode. 2nd picture shows the position of the cube and armature after the bone was selected in Edit Mode, moved and switched back into Pose Mode. Notice that the child object does not move to the new location of the pose bone.

Note

When using `Ctrl-P` to set parents, choosing "Bone" or "Bone Relative" will respectively clear and set the bone's "Relative Parenting" option.

Since “Relative Parenting” is an option that is set per bone, this influences all child objects of that bone at once.

Vertex Parent

For objects of type curve, surface, mesh and lattice, there is the possibility to use one of its vertices or points as the parent of other objects. You can parent an object to a single vertex or a group of three vertices as well; that way the child/children will move when the parent mesh is deformed.

Vertex Parent from Edit Mode

In *Object Mode*, select the child/children and then the parent object. `Tab` into *Edit Mode* and on the parent object select either one vertex that defines a single point, or select three vertices that define an area (the three vertices do not have to form a complete face; they can be any three vertices of the parent object), and then press `Ctrl-P` and confirm.

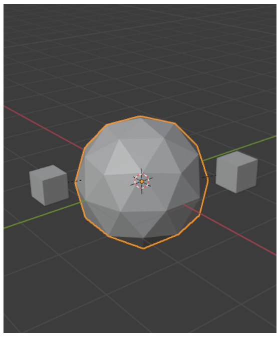
At this point, if a single vertex was selected, a relationship/parenting line will be drawn from the vertex to the child/children. If three vertices were selected then a relationship/parenting line is drawn from the averaged center of the three points (of the parent object) to the child/children. Now, as the parent mesh deforms and the chosen parent vertex/vertices move, the child/children will move as well.

Vertex Parent from Object Mode

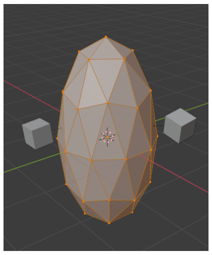
Vertex parenting can be performed from Object Mode, this is done like regular object parenting, press `Ctrl-P` in Object Mode and select *Vertex* or *Vertex (Triangle)*.

The nearest vertices will be used from each object which is typically what you would want.

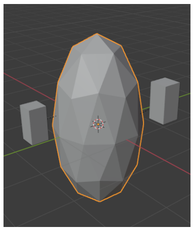
Vertex Parent example.



The small cubes can each be automatically parented to a triad of nearby vertices on the icosphere using the “Vertex (Triangle)” in the set parent context menu.



Reshaping the object in Edit Mode then means each of the cubes follows their vertex parent separately.



Scaling the parent icosphere in Object Mode means the child cubes are also scaled as expected.

The parent context menu item means users can rapidly set up a large number of vertex parent relationships, and avoid the tedious effort of establishing each parent-child vertex relationship separately.

Note

It is in fact a sort of “reversed” hook.

Make Parent without Inverse

Reference

Mode:: Object Mode

Menu::	*Object ▸ Parent ▸ Make Parent without Inverse*

This sets the parent, and then resets the *Parent Inverse* matrix and the object's local location. As a result, the object will move to the location of the parent, but keep its rotation and scale.

Keep Transform

The object's current world transform (so its absolute location, rotation and scale in the world) is computed. The new parent is set, and then the local transform values are set in such a way that after setting the new parent the object is still at its previous world transform.

Clear Parent

Reference

Mode::	Object Mode
Menu::	*Object ▸ Parent*
Shortcut::	`Alt-P`

You can *remove* a parent-child relationship via `Alt-P`.

Clear Parent

If the parent in the group is selected, nothing is done. If a child or children are selected, they are disassociated from the parent, or freed, and they return to their *original* location, rotation, and size.

Clear and Keep Transformation

Frees the children from the parent, and *keeps* the location, rotation, and size given to them by the parent.

See Non-Uniform Scale which may apply here.

Clear Parent Inverse

Instead of removing the hierarchical parent-child relationship, this clears the Parent Inverse matrix from the selected objects. With an

Modifiers

Operators for working with an object's Modifiers.

Add Modifier

Reference

Mode::	Object Mode
Menu::	*Object ‣ Modifiers ‣ Add Modifier*

Opens a menu with a list of modifiers, selecting a modifier will add it to the bottom of The Modifier Stack.

Copy Modifiers to Selected Objects

Reference

Mode::	Object Mode
Menu::	*Object ‣ Modifiers ‣ Copy Modifiers to Selected Objects*

Copies all modifiers from the Active object to the other selected objects.

Clear Object Modifiers

Reference

Mode::	Object Mode
Menu::	*Object ‣ Modifiers ‣ Clear Object Modifiers*

Deletes all modifiers from the selected objects.

Constraints

Operators for working with an object's Constraints.

Add Constraint (with Targets)

Reference

Mode::	Object Mode and Pose Mode
Menu::	*Object ‣ Constraint ‣ Add Constraint (with Targets)*

Adds a constraint to the active object. The type of constraint must be chosen from a pop-up menu, though it can be changed later from the *Add Constraint (with Targets)* Adjust Last Operation panel. If there is an other object selected besides the active one, that object will be the constraint target (if the chosen constraint accepts targets).

When using a bone from another armature as the target for a constraint, the tool will look inside the non-active armature and use its active bone, provided that armature is in Pose Mode.

Copy Constraints to Selected Objects

Reference

Mode::	Object Mode and Pose Mode
Menu::	*Object ‣ Constraint ‣ Copy Constraints to Selected Objects*

Copies the active object Constraints to the rest of the selected objects.

Clear Object Constraints

Reference

Mode:: Object Mode and Pose Mode
Panel:: *Object* ▸ *Constraint* ▸ *Clear Object Constraints*

Removes all Constraints of the selected object(s).

Track

Reference

Mode:: Object Mode
Panel:: *Object ▸ Track*

These tools add a tracking constraint to the selected objects; the target object of the constraint will be the active object, which won't have a constraint added.

- Damped Track Constraint
- Track To Constraint
- Lock Track Constraint

Clear Track

Removes all Damped Track, Track To and Lock Track Constraints from the selected objects.

Clear and Keep Transformation (Clear Track)

Removes all Track Constraint from the selected objects, while keeping the final transform caused by them.

Relations

- Make Single User

Make Single User

Reference

Mode::	Object Mode
Menu::	*Object ‣ Relations ‣ Make Single User*

Makes the selected or all object data-blocks single users, that is, not shared (linked) between other objects in the blend-file.

Additionally, it can also make single-user copies of its dependencies, like meshes, curves, materials, animations…

Type

These actions work on the selected objects, or on all the objects of the scene.

All, Selected Objects

Data-blocks

Lets you, in addition to the menu predefined selection, choose the type of data-blocks individually.

Object::	Make single user objects.
Object Data::	Make single user object data.
Materials::	Make materials local to each data-block.
Object Animation::	Make the animation of Object Properties data local to each object.
Object Data Animation::	Make object data (mesh, curve etc.) animation data local to each object.

See also

Making Single User

Link/Transfer Data

Reference

Mode:: Object Mode
Menu:: *Object ▸ Link/Transfer Data*
Shortcut:: `Ctrl-L`

- Link Objects to Scene
- Link Data
    - Link Object Data
    - Link Materials
    - Link Animation Data
    - Link Collections
    - Link Instance Collection
    - Link Fonts to Text
    - Copy Modifiers
    - Copy Grease Pencil Effects
- Copy UV Maps
- Transfer Mesh Data
    - Vertex Mapping
    - Further Options
- Transfer Mesh Data Layout

Link Objects to Scene

Reference

Mode::	Object Mode
Menu::	*Object* ▸ *Link/Transfer Data* ▸ *Link Objects to Scene*

Links the selected objects into a different scene than the current one. The *Link Objects to Scene* in the Adjust Last Operation panel lets you choose between scenes.

This makes the same object exist in more than one scene at once, including its position and animation data. The object’s origin will change its color to reflect that.

Link Data

Reference

Mode:: Object Mode
Menu:: *Object ‣ Link/Transfer Data…*

Links objects between scenes or data-blocks of the active object to all selected objects. In some case (i.e. Object Data, Modifier) the target objects must be of the same type as the active one or capable of receiving the data. If targets already have data linked to them, it will be unlinked first.

Type

Data-block type to link.

- Link Object Data
- Link Materials
- Link Animation Data
- Link Collections
- Link Instance Collection
- Link Fonts to Text
- Copy Modifiers
- Copy Grease Pencil Effects

See also

Making Single User for unlinking data-blocks.

Link Object Data

Replace assigned Object Data.

Link Materials

Replace assigned Materials.

Link Animation Data

Replace assigned Animation Data.

Link Collections

Replace assigned Collections.

Link Instance Collection

Replace assigned Collection Instance.

Link Fonts to Text

Replace Text object Fonts.

Copy Modifiers

Replace Modifiers.

Copy Grease Pencil Effects

Replace Grease Pencil Effects.

Copy UV Maps

Reference

Mode::	Object Mode
Menu::	*Object ‣ Link/Transfer Data ‣ Copy UV Maps*

The active UV map of the selected objects will be replaced by a copy of the active UV map of the active object. If the selected object doesn’t have any UV maps, it is created. Objects must be of type mesh and must have a matching topology.

Transfer Mesh Data

Reference

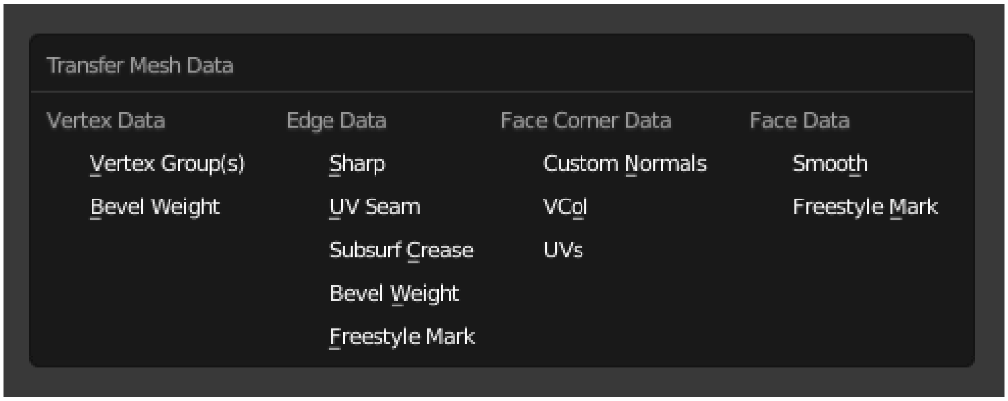
Mode:: Object Mode
Menu:: *Object ‣ Link/Transfer Data ‣ Transfer Mesh Data*

The *Data Transfer* tool transfers several types of data from one mesh to another. Data types include vertex groups, UV maps, Color Attributes, custom normals… Transfer works by generating a mapping between source mesh's elements (vertices, edges, etc.) and destination ones, either on a one-to-one basis, or mapping several source elements to a single destination one by interpolated mapping.

Transfers data layer(s) from active to selected meshes.

Freeze Operator
: Prevent changes to settings to re-run the operator. This is useful if you are editing several settings at once with heavy geometry.

Data Type
: Which data to transfer.


Transfer Mesh Data
Vertex Data
Vertex Group(s)
Bevel Weight
Edge Data
Sharp
UV Seam
Subsurf Crease
Bevel Weight
Freestyle Mark
Face Corner Data
Custom Normals
VCol
UVs
Face Data
Smooth
Freestyle Mark

Data types.

Create Data

Add data layers on destination meshes if needed.

Vertex Mapping

Method used to map source vertices to destination ones. Because the options change depending on the *Data Type* options are explained in Vertex Mapping below.

Vertex Mapping

Topology

The simplest option, expects both meshes to have identical number of elements, and match them by order (indices). Useful e.g. between meshes that were identical copies, and got deformed differently.

One-To-One Mappings

Those always select only one source element for each destination one, often based on shortest distance.

Vertices

Nearest Vertex

Uses source's nearest vertex.

Nearest Edge Vertex

Uses source's nearest vertex of source's nearest edge.

Nearest Face Vertex

Uses source's nearest vertex of source's nearest face.

Edges

Nearest Vertices

Uses source's edge which vertices are nearest from destination edge's vertices.

Nearest Edge

Uses source's nearest edge (using edge's midpoints).

Nearest Face Edge

Uses source’s nearest edge of source’s nearest face (using edge’s midpoints).

Face Corners

A face corner is not a real element by itself, it’s some kind of split vertex attached to a specific face. Hence both vertex (location) and face (normal, …) aspects are used to match them together.

Nearest Corner and Best Matching Normal

Uses source’s corner having the most similar *split* normal with destination one, from those sharing the nearest source’s vertex.

Nearest Corner and Best Matching Face Normal

Uses source’s corner having the most similar *face* normal with destination one, from those sharing the nearest source’s vertex.

Nearest Corner of Nearest Face

Uses source’s nearest corner of source’s nearest face.

Faces

Nearest Face

Uses source’s nearest face.

Best Normal-Matching:

Uses source’s face which normal is most similar with destination one.

Interpolated Mappings

Those use several source elements for each destination one, interpolating their data during the transfer.

Vertices

Nearest Edge Interpolated

Uses nearest point on nearest source’s edge, interpolates data from both source edge’s vertices.

Nearest Face Interpolated

Uses nearest point on nearest source's face, interpolates data from all that source face's vertices.

Projected Face Interpolated

Uses point of face on source hit by projection of destination vertex along its own normal, interpolates data from all that source face's vertices.

Edges

Projected Edge Interpolated

This is a sampling process. Several rays are cast from along the destination's edge (interpolating both edge's vertex normals), and if enough of them hit a source's edge, all hit source edges' data are interpolated into destination one.

Face Corners

A face corner is not a real element by itself, it's some kind of split vertex attached to a specific face. Hence both vertex (location) and face (normal, …) aspects are used to match them together.

Nearest Face Interpolated

Uses nearest point of nearest source's face, interpolates data from all that source face's corners.

Projected Face Interpolated

Uses point of face on source hit by projection of destination corner along its own normal, interpolates data from all that source face's corners.

Faces

Projected Face Interpolated

This is a sampling process. Several rays are cast from the whole destination's face (along its own normal), and if enough of them hit a source's face, all hit source faces' data are interpolated into destination one.

Further Options

Auto Transform

Automatically computes the transformation to get the best possible match between source and destination meshes.

This allows to match and transfer data between two meshes with similar shape, but transformed differently. Note that you'll get best results with exact copies of the same mesh. Otherwise, you'll likely get better results if you "visually" make them match in 3D space (and use *Object Transform*) instead.

Object Transform

Evaluate source and destination meshes in global space.

Only Neighbor Geometry

Source elements must be closer than given distance from destination one.

Max Distance

Maximum allowed distance between source and destination element (for non-topology mappings).

Ray Radius

The starting ray radius to use when Ray Casting against vertices or edges. When transferring data between meshes Blender performs a series of ray casts to generate mappings. Blender starts with a ray with the radius defined here, if that does not detect a hit then the radius is progressively increased until a positive hit or a limit is reached.

This property acts as an accuracy/performance control; using a lower ray radius will be more accurate however, might take longer if Blender has to progressively increase the limit. Lower values will work better for dense meshes with lots of detail while larger values are probably better suited for simple meshes.

Mix Mode

How to affect destination elements with source values.

All
  Replaces everything in destination (note that *Mix Factor* is still used).

Above Threshold
  Only replaces destination value if it is above given threshold *Mix Factor*. How that threshold is interpreted depends on data type, note that for Boolean values this option fakes a logical AND.

Below Threshold
  Only replaces destination value if it is below given threshold *Mix Factor*. How that threshold is interpreted depends on data type, note that for Boolean values this option fakes a logical OR.

Mix, Add, Subtract, Multiply
  Apply that operation, using mix factor to control how much of source or destination value to use. Only available for a few types (vertex groups, Color Attributes).

Mix Factor
  How much of the transferred data gets mixed into existing one (not supported by all data types).

Transfer Mesh Data Layout

Reference

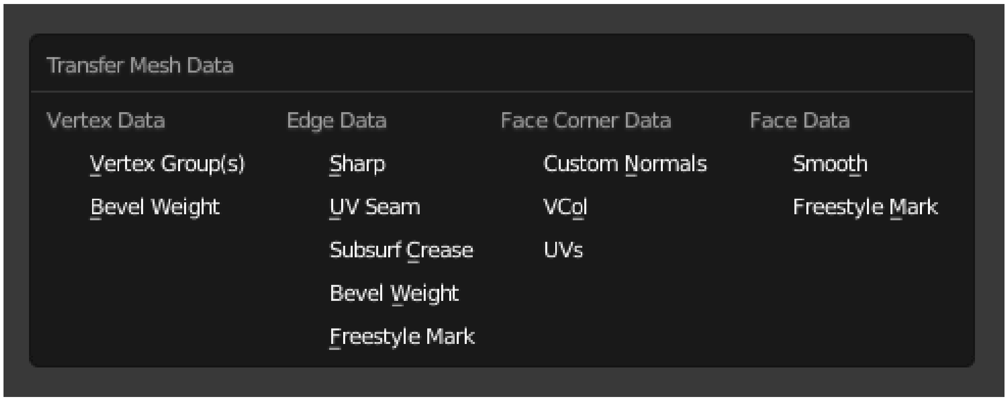
Mode:: Object Mode

Menu:: *Object ‣ Link/Transfer Data ‣ Transfer Mesh Data Layout*

Transfers layout of data layer(s) from active to selected meshes.

Data Type

Which data to transfer.


Transfer Mesh Data
Vertex Data
Vertex Group(s)
Bevel Weight
Edge Data
Sharp
UV Seam
Subsurf Crease
Bevel Weight
Freestyle Mark
Face Corner Data
Custom Normals
VCol
UVs
Face Data
Smooth
Freestyle Mark

Data types.

Exact Match

Also Delete some data layers from destination if necessary, so that it matches the source exactly.

Source Layers Selection

Which layers to transfer, in case of multi-layer types.

Active Layer

Only transfer the active data layer.

All Layers

Transfer all data layers.

Destination Layers Matching

How to match source and destination layers.

By Name

Match target data layers to affect by name.

By Order

Match target data layers to affect by order (indices).

See also

Data Transfer Modifier

Shading

Shade Smooth

Reference

Mode::	Object Mode
Menu::	*Object* ▸ *Shade Smooth*

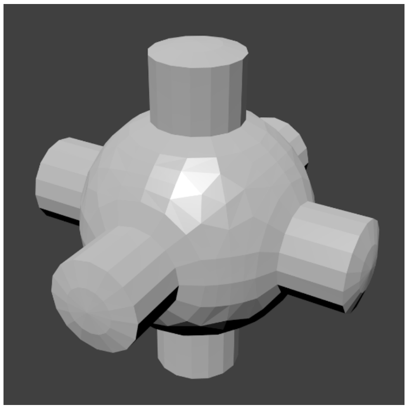
Sets an entire object as smooth or faceted. This forces the assignment of the "smoothing" attribute to each face in the mesh, including when you add or delete geometry.

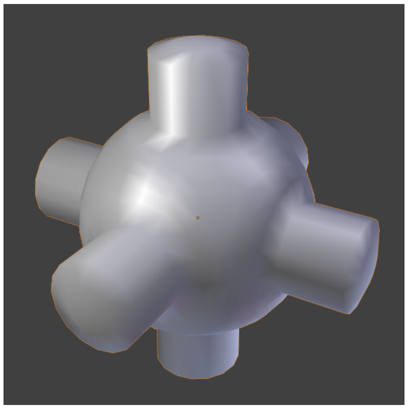
This operator will also remove any Smooth By Angle Modifiers.

Notice that the outline of the object is still strongly faceted. Activating the smoothing features does not actually modify the object's geometry; it changes the way the shading is calculated across the surfaces (normals will be interpolated), giving the illusion of a smooth surface.

Using Shade Flat will revert the shading back (normals will be constant) to that shown in the first image below.

Example mesh flat (left) and smooth-shaded (right). Sample blend-file.





Keep Sharp Edges
    Do not clear sharp edges (which are redundant with objects shaded as flat or smooth). This option is useful to not destroy data in case you want to revert changes later.

Shade Auto Smooth

Reference

Mode::	Object Mode
Menu::	*Object ‣ Shade Auto Smooth*

Adds a Smooth By Angle Modifier to automatically set the sharpness of mesh edges based on the angle between the neighboring faces. Note, the modifier will be pinned to be the last modifier.

Auto Smooth
    If disabled, any Smooth By Angle Modifiers are removed.

Angle
    Maximum angle between face normals that will be considered as smooth.

Shade Flat

Rigid Body

Calculate Mass

Reference

Editor::	3D Viewport
Mode::	Object Mode
Menu::	*Object ‣ Rigid Body ‣ Calculate Mass*

Calculate mass values for rigid body objects based on their volume and density. The volume is calculated automatically, the density needs to be given based on the object you want to simulate.

Material Preset
: A list of preset density values for real-world materials, if a material is not given you can research the density and use the *Custom* preset to input the density manually.

Density
: When the *Custom Material Preset* is selected, this is the input density, in kg/m^3, to use.

Convert

Curve

Reference

Mode::	Object Mode
Menu::	*Object ‣ Convert ‣ Curve*

Converts the selected mesh, or text object to a curve object. For mesh objects, only edges belonging to no faces will be taken into account. The resulting curve will be a poly curve type, but can be converted to have smooth segments as described in Set Spline Type.

Mesh

Reference

Mode::	Object Mode
Menu::	*Object ‣ Convert ‣ Mesh*

Converts the selected curve, metaball, surface, or text object to a mesh object. The actual defined resolution of these objects will be taken into account for the conversion. Note that it also keeps the faces and volumes created by closed and extruded curves.

Grease Pencil

Reference

Mode::	Object Mode
Menu::	*Object ‣ Convert ‣ Grease Pencil*

Converts the selected curve, mesh or text object to a Grease Pencil object with strokes matching the curve, mesh, or text; basic materials are also added. When multiple curves, meshes, or texts are selected, they are all converted into the same Grease Pencil object.

Options

Keep Original
: Duplicates the original object before converting it.

Thickness
: Strokes thickness.

Threshold Angle
: Threshold value that determines the strokes end.

Stroke Offset
: Sets offset to separate strokes from filled strokes.

Only Seam Edges
: Convert only edges marked as seam.

Export Faces
: Convert faces as filled strokes.

Trace Image to Grease Pencil

Reference

Mode::	Object Mode
Menu::	*Object ‣ Convert ‣ Trace Image to Grease Pencil*

See Trace Image to Grease Pencil.

Convert to Mesh Plane

Reference

Mode:: Object Mode
Menu:: *Object ‣ Convert ‣ Convert to Mesh Plane*

Converts the selected image empty to a textured mesh plane.

For a description of the options see Import Images as Planes.

Show/Hide

Reference

Mode::	All Modes
Menu::	*Object ‣ Show/Hide*

Show Hidden Objects `Alt-H`
Reveals all hidden objects.

Hide Selected `H`
Hides all selected objects.

Hide Unselected `Shift-H`
Hides all unselected objects of the scene.

Clean Up

Clean Vertex Group Weights

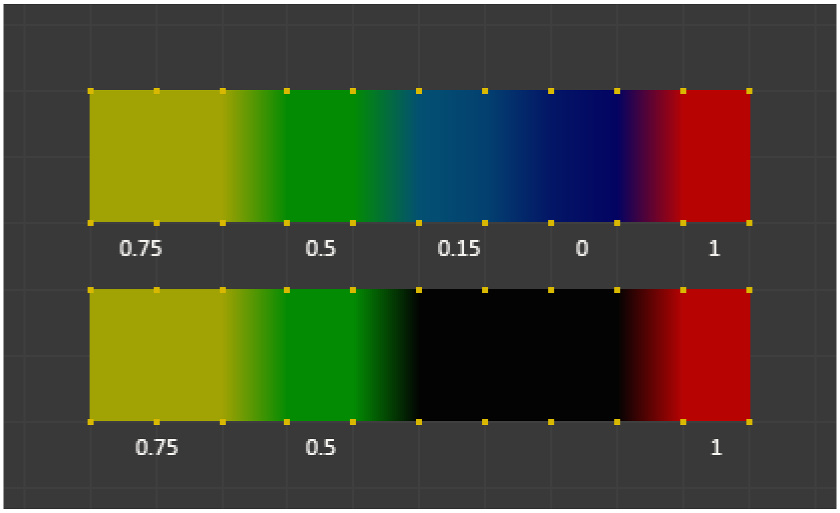
Reference

Mode::	Object Mode
Menu::	*Object* ‣ *Clean Up* ‣ *Clean Vertex Group Weights*

Clean Vertex Group Weights unassigns vertices from Vertex Groups whose weights are below the *Limit*. Removes weights below a given threshold. This tool is useful for clearing your weight groups of very low (or zero) weights.

In the example shown, a cutoff value of 0.2 is used (see operator options below) so all blue parts are cleaned out.

Note, the images use the *Show Zero weights* Active option so that unreferenced Weights are shown in Black.



Clean example.

Subset

Restrict the tool to a subset. See above The Subset Option for how subsets are defined.

Limit

This is the minimum weight value that will be kept in the group. Weights below this value will be removed from the group.

Keep Single

Ensure that the *Clean Vertex Group Weights* tool will not create completely unreferenced vertices (which are vertices that are not assigned to any vertex group), so each vertex will keep at least one weight, even if it is below the limit value!

Limit Total Vertex Groups

Reference

Mode:: Object Mode

Menu:: *Object ‣ Clean Up ‣ Limit Total Vertex Groups*

Reduce the number of weight groups per vertex to the specified Limit. The tool removes lowest weights first until the limit is reached.

Hint

The tool can only work reasonably when more than one weight group is selected.

Subset

Restrict the tool to a subset. See above The Subset Option for how subsets are defined.

Limit

Maximum number of weights allowed on each vertex.

Remove Unused Material Slots

Reference

Mode:: Object Mode
Menu:: *Object ‣ Clean Up ‣ Remove Unused Material Slots*

Removes unused material slots.

Delete

Reference

Mode::	Object Mode
Menu::	*Object ‣ Delete*
Shortcut::	`X` or `Delete`

Delete the selected objects from the current scene.

Delete Globally

Reference

Mode::	Object Mode
Menu::	*Object ‣ Delete Globally*
Shortcut::	`Shift-X` or `Shift-Delete`

Delete the selected objects from all scenes, and any other possible usages (like e.g. from a shading node).

Properties

- Transform
    - Delta Transforms
- Relations
- Collections
    - Introduction
    - Collections
- Instancing
    - Vertices
    - Faces
    - Collection
- Visibility
- Viewport Display
- Line Art

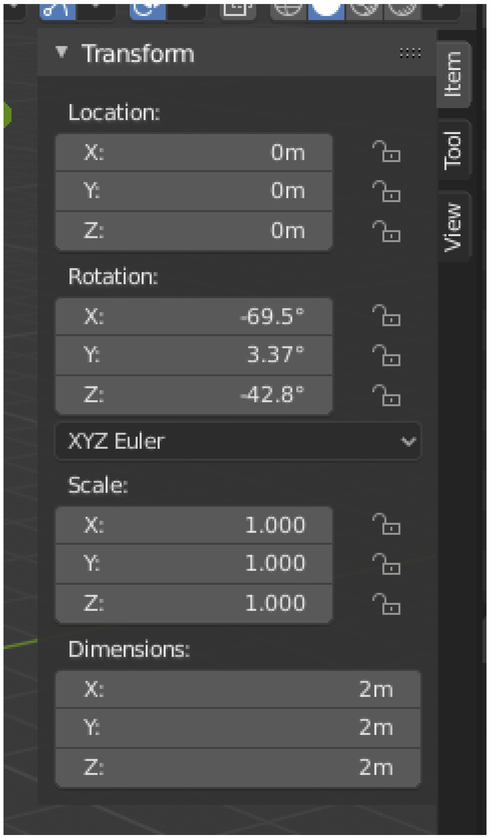
Transform

Reference

Mode:: Object Mode
Panel:: *Properties* ‣ *Object Properties* ‣ *Transform*
Panel:: *3D Viewport* ‣ *Sidebar* ‣ *Transform*

The *Transform* panel in the Sidebar region allows you to view and manually/numerically control the position, rotation, and other properties of an object, in *Object Mode*. Each object stores its position, orientation, and scale values. These may need to be manipulated numerically, reset, or applied. In *Edit Mode*. It mainly allows you to enter precise coordinates for a vertex, or median position for a group of vertices (including an edge/face). As each type of object has a different set of options in its *Transform* panel in *Edit Mode*, see their respective descriptions in the Modeling chapter.

Use this panel to either edit or display the object's transform properties such as position, rotation and/or scaling. These fields change the object's origin and then affect the aspect of all its *vertices* and faces.



Transform

Location:
X: 0m
Y: 0m
Z: 0m

Rotation:
X: -69.5°
Y: 3.37°
Z: -42.8°

XYZ Euler

Scale:
X: 1.000
Y: 1.000
Z: 1.000

Dimensions:
X: 2m
Y: 2m
Z: 2m

Transform Properties.

Location

The object’s origin location in local coordinates.

Rotation

The object’s local orientation, relative to the global axes and its own origin.

Rotation Mode

Method for calculating rotations, additional information can be found in the manual’s appendix.

Euler::	The gizmo handles are aligned to the Euler axis, allowing you to see the discreet XYZ axis underlying the Euler rotation, as well as possible Gimbal Lock.
Axis Angle::	

	The X, Y, and Z coordinates define a point relative to the object origin. This point and the origin define an axis around the W value defines the rotation.
Quaternion::	X, Y, Z and W correspond to the Quaternion components.

Scale

The object's relative scale along the local axis (e.g. the *Scale X* value represents the scale along the local X axis). Each object (cube, sphere, etc.), when created, has a scale of one unit in each local direction. To make the object bigger or smaller, you scale it in the desired axis.

Dimensions

The size of the object's bounding box (aligned with the local axes – think of a cardboard box just big enough to hold the object).

Transform Properties Locking

When the toggle is locked, the corresponding transformation value can not be changed in any interactive operation. But the value can still be changed using non-interactive operations, like editing the corresponding number field or using Python.

For example, if you locked the *Location X* property then you cannot use the 3D gizmo to move the object along the global X axis. But you can still move it using the *Location X* number field. Consider the locking feature as a rigid constraint only changeable from the panel.

To lock a property, click the padlock icon next to the button. The button is unlocked if the icon shows an open padlock, and it is locked if the icon appears as a closed padlock.

Delta Transforms

Reference

Mode::	Object Mode

Panel:: *Properties* ▸ *Object Properties* ▸ *Transform* ▸ *Delta Transforms*

Delta Transforms are simply transformations that are applied on top of the transforms described above. Delta Transforms are particularly useful in animations. For example, you can animate an object with the primary transforms then move them around with Delta Transforms.

Relations

Reference

Mode:: Object Mode
Panel:: *Properties* ‣ *Object Properties* ‣ *Relations*

Parent

The object to which the selected object is parented to.

Parent Type

The type of parenting used. See parenting for information on the different types.

Camera Parent Lock

When the camera is locked to the view, the root parent is transformed rather than the camera. This is useful for camera rigs where you don’t want to animate the camera directly.

Tracking Axis

Axis that points in the “forward” direction. Applies to *Instance Vertices* when *Align to Vertex Normal* is enabled.

Up Axis

Axis that points in the “upward” direction. Applies to *Instance Vertices* when *Align to Vertex Normal* is enabled.

Pass Index

Defines the index the object will have in the Object Index render pass. See passes and ID mask for more information.

Note

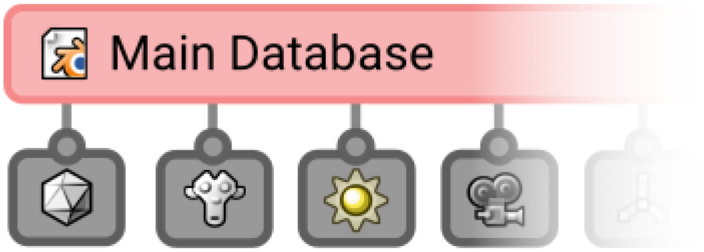
Volume Objects are not supported.

Collections

- Introduction
  - Collections
  - Naming and Nesting
  - Color Tagging
- Collections
  - Collections Tab
  - Collections Menu
  - Collections Panel

Introduction

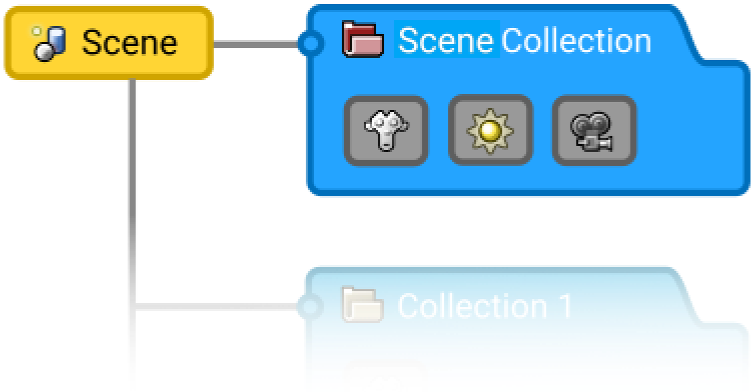
In Blender, objects are not directly part of the scenes. Instead, they all get stored in a main database (basically the blend-file).


Main Database

The blend-file and its stored data.

From there they are referenced into as many Scenes as you would like to see them.

When they are stored in a scene, they are part of a so-called *scene collection*. So ultimately all the scene objects belong to this special collection.

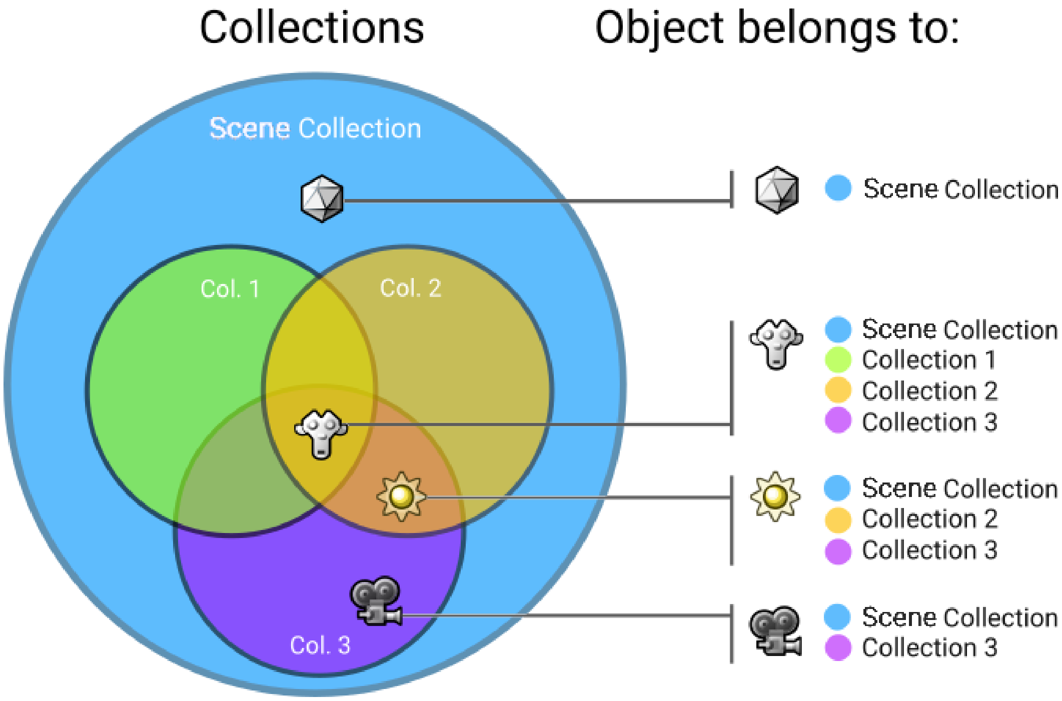

Scene
Scene Collection
Collection 1

The scene collection.

Collections

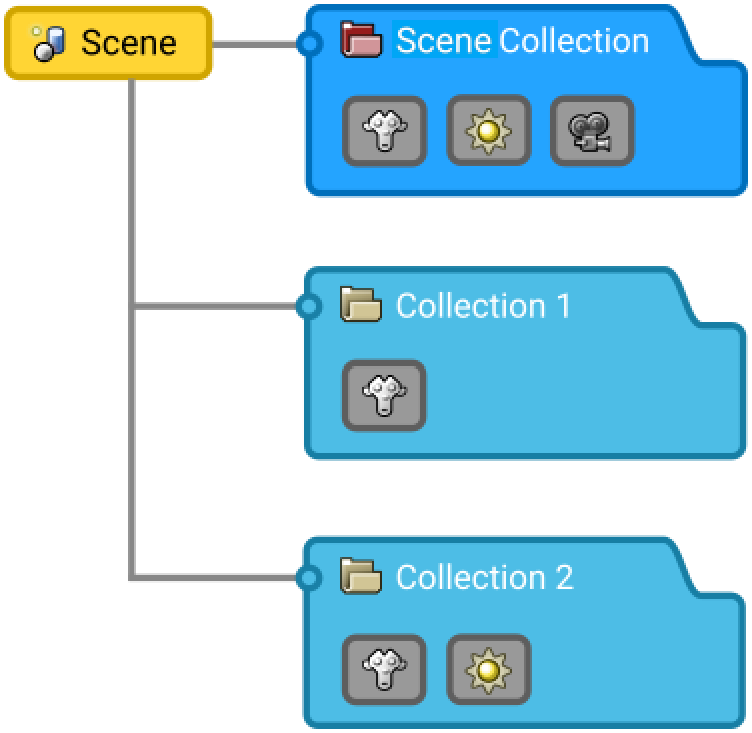
While the *scene collection* contains all the Scene's objects, the user can also make their own collections to better organize these objects.

It works like a Venn diagram, where all the objects are part of the *scene collection*, but can also be part of multiple collections.


Collections
Object belongs to:
Scene Collection
Col. 1
Col. 2
Col. 3
Scene Collection
Scene Collection
Collection 1
Collection 2
Collection 3
Scene Collection
Collection 2
Collection 3
Scene Collection
Collection 3

Venn diagram.

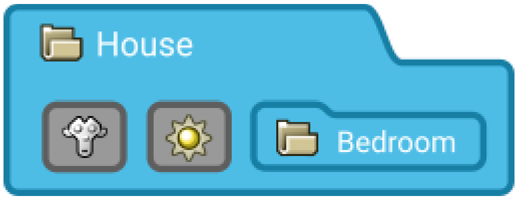
The result is a clear and flexible way to arrange objects together on the Scene level.


Scene
Scene Collection
Collection 1
Collection 2

Scene organization.

Naming and Nesting

Collections can be named and sorted hierarchically. Just like folders can have subfolders in any operating system, collections can have nested collections too.


House
Bedroom

Nested collections.

For example: a *house* collection can contain a *bedroom* collection, which in turn contains a *furniture* collection referencing a bed, a cabinet and other objects.

Color Tagging

Collections can have a color group assigned to them; helping organize and group different collections. This color tag is displayed as part of the collection icon in the Outliner and various other menus. The available colors are defined by Blender's interface Theme.

To assign a color to a collection, use the Set Color Tag tool in the Outliner.

Collections

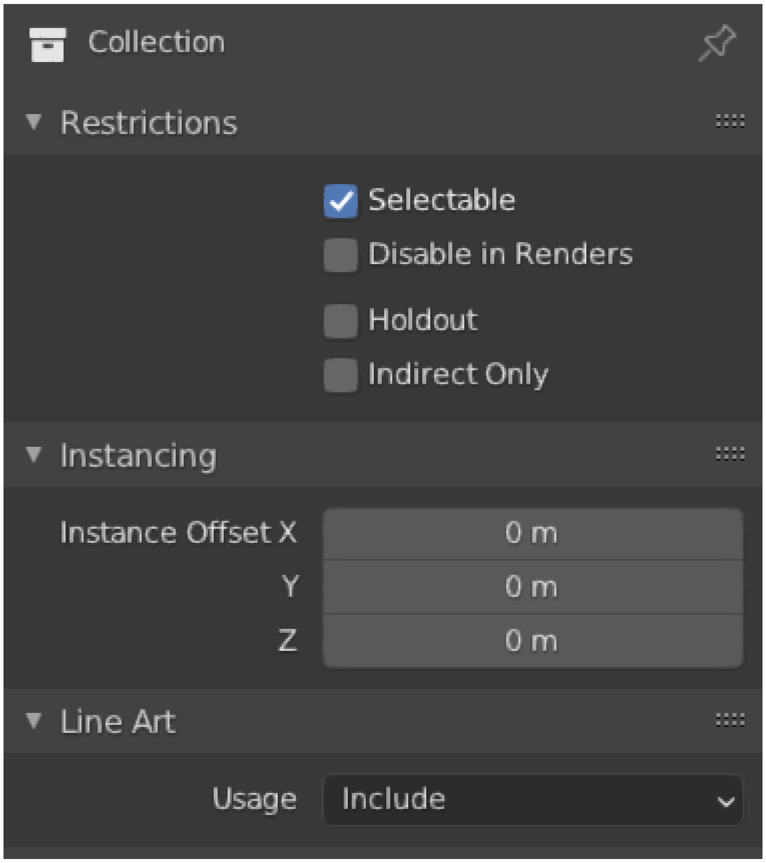
There can be many objects in a scene: A typical stage scene consists of furniture, props, lights, and backdrops. Blender helps you keep everything organized by allowing you to group like objects together. Objects can be grouped together without any kind of transformation relationship (unlike parenting). Collections are used to just logically organize your scene, or to facilitate one-step appending or linking between files or across scenes.

Collections Tab

Reference

Menu:: *Properties* ▸ *Collection Properties*

Collection properties tab allows convenient access to properties for the active collection.



☑ Selectable
☐ Disable in Renders
☐ Holdout
☐ Indirect Only

Instance Offset X: 0 m
Y: 0 m
Z: 0 m

Usage: Include

Collection properties.

Restrictions

Selectable
: Toggles the ability to select the objects from the 3D Viewport. This is useful for if you have placed something in the scene and do not want to accidentally select it when working on something else.

Disable in Renders
: Enables/disables visibility of the collection in renders.

Holdout
: Objects inside this collection will generate a holdout/mask in the active view layer.

Indirect Only

Objects inside this collection will only contribute to the final image indirectly through shadows and reflections.

Instancing

Instance Offset X, Y Z

Applies a spatial offset of the instanced collections from the original object's origin.

Exporters

Each collection can be exported to a number of various file formats. These exporters are available globally, see Importing & Exporting Files, however, this panel streamlines the process of re-exporting the same asset(s) repeatedly. For example when creating glTF assets for a game and iterating on the look, or when using Blender in a studio pipeline to create USD assets.

The following file formats are supported, see each for the documentation of export parameters:

- Alembic
- Universal Scene Description
- Wavefront OBJ
- Stanford PLY
- FBX
- glTF 2.0

Exporter List

A list view of all the enabled exporters for the active collection. The selecting an exporter from the list will show it's options in a sub panel below.

Exporters can be added/removed through the + and – icons to right of the Exporter list.

Export All

Exports all exports for the active collection.

Tip

Use *File* ▸ *Export All Collections* to export all exporters for all collections.

Line Art

Usage

How the collection is loaded into line art. Child objects of the collection can override this setting if they wish in Object Properties.

Include::	Generate feature lines for this collection.
Occlusion Only::	Objects in the collection will only cause occlusion to existing feature lines and their geometry stay invisible.
Exclude::	Objects in this collection will not be loaded into line art at all.
Intersection Only::	Objects in the collection will only produce intersection lines in the scene and their own geometry stay invisible.
No Intersection::	Include this collection but do not generate intersection lines.
Force Intersection::	Generate intersection lines even with objects that disabled intersection.

Collection Mask

Use custom intersection mask for faces in this collection. Intersection masks can be used by the Line Art modifier to filter lines. See Collection Masks for more information.

Mask

Intersections generated by this collection will have this mask value.

Intersection Priority

Assigns an intersection priority value for this collection. The intersection line will be included into the object with the higher intersection priority value.

Custom Properties

Create and manage your own properties to store data in the collection’s data block. See the Custom Properties page for more information.

Collections Menu

Reference

Mode::	Object Mode
Menu::	*Object ‣ Collection*
Shortcut::	`M`, `Shift-M`, `Ctrl-G`, etc.

Move to Collection `M`

Move selected objects to an existing or new collection.

Link to Collection `Shift-M`

Add selected objects to a collection, while keeping them in their current collection. This way objects can appear in multiple collections. A new collection can be created in the pop-up.

Create New Collection `Ctrl-G`

Creates a new collection and adds the selected object(s) to it. The name of the new collection can be specified in the *Create New Collection* Adjust Last Operation panel. This collection is not linked to the active scene.

Remove from Collection `Ctrl-Alt-G`

Remove the selected objects from a collection. If the object belongs to more than one collection, a pop-up lets you select the collection and an option to remove it from all collections.

Remove from All Collections `Shift-Ctrl-Alt-G`

Remove the selected objects from all collections.

Add Selected to Active Collection `Shift-Ctrl-G`

Adds the selected objects to the collections to which the active object belongs.

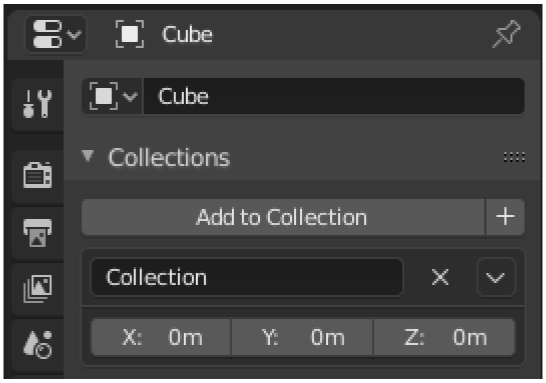
Remove Selected from Active Collection `Shift-Alt-G`

Causes the selected objects to be removed from the collections to which the active object belongs.

Collections Panel

Reference

Mode:: Object Mode
Panel:: *Object tab ‣ Collections*



Collections panel.

All collections that an object has been assigned to are listed in the Properties *Object tab ‣ Collections panel*.

Add to Collection

Adds the selected object to a collection. A pop-up lets you specify the collection to add to.

New +

Creates a new collection and adds the selected object to it.

Name

    To rename a collection, simply click in the collections name field.

(Remove Collection)

    Removes the object from the specified collection.

Specials

    Unlink Collection, Select Collection, Set Offset from Cursor

Offset

    Applies a spatial offset of the instanced collections from the original object's origin.

See also

Appending or Linking Collections

To append a collection from another blend-file, consult this page. In summary, *File* ▸ *Link/Append Link* Select a blend-file and then the collection.

Tip

Selecting Collections

Collections can be selected, see Select Grouped for more information.

Instancing

Note

Geometry nodes provides a more flexible way to instance objects, with the Instance on Points Node.

Vertices
: This creates an instance of all children of this object on each vertex (for mesh objects only).

Faces
: This creates an instance of all children of this object on each face (for mesh objects only).

Collection
: This creates an instance of the collection with the transformation of the object. Collection instancers can be animated using actions, or can get a Library Override.

- Vertices
  - Usage
- Faces
  - Basic Usage
  - Scale
  - Limitations/Considerations
- Collection
  - Basic Usage
  - Collections and Dynamic Linking
  - Making an Instanced Collection Real

Vertices

Reference

Mode::	Object Mode
Panel::	*Properties* ▸ *Object Properties* ▸ *Instancing*

Instance Vertices allows you to replicate child objects at the location of every vertex of the parent object.

Note

The relative Object Origin position of the parent and child objects determines offset instanced geometry from parent vertex.

Align to Vertex Normal

Rotates all instanced objects according to the corresponding vertex normals of the parent mesh.

To change the axis of direction of the instanced objects, select the child object and change the Tracking Axis.

There are actually two approaches to modeling using instanced vertices. They can be used as an arranging tool, allowing you to model geometrical arrangements of objects (e.g. the columns of a Greek temple, the trees in a garden, the desks in a classroom). The object can be of any object type which Blender supports. The second approach is to use them to model an object starting from a single part of it (e.g. the spikes in a club, the thorns of a sea-urchin, the tiles in a wall, the petals in a flower).

Note

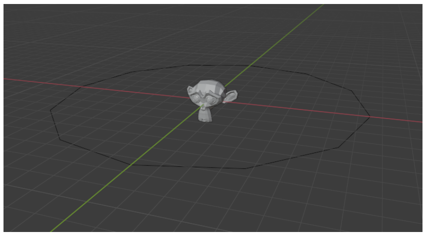
Download Example Blend-File

You can download a file with the examples described on this page. In this blend, the first example, a monkey parented to a circle is on layer 1; while a tentacle parented to an icosphere is on layer 2.

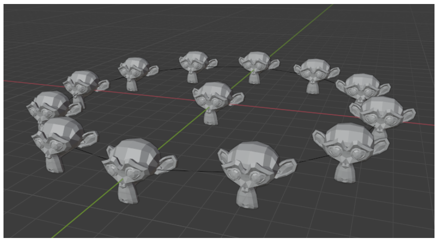
Usage

Instanced Vertices as an Arranging Tool

All you need is a base object (e.g. the *tree* or the *column*) and a pattern mesh with its vertices following the pattern you have in mind. In this section, we will use a simple scene for the following part. We will be using a monkey head located at the origin of the coordinate system as our base object and a circle at the same location as our parent mesh.



A monkey head and a circle.



Instanced monkeys on Vertices.

First, in *Object Mode*, select the base object and `Shift-LMB` to add the circle to the selection (order is very important here), and `Ctrl-P` or *Object* ‣ *Parent* ‣ *Object* to parent the base object to the circle. Now, the circle is the parent of the monkey; if you move the circle, the monkey will follow it.

With only the circle selected, enable *Instancing Vertices*; a monkey head should be placed at every vertex of the circle.

The original monkey head at the center and the parent mesh are still shown in the 3D Viewport but neither will be rendered. If the placement and rotation of your monkey head are odd, you might need to clear its rotation `Alt-R`, scale `Alt-S`, location `Alt-G`, and origin *Object ‣ Clear ‣ Origin*.

Rearranging

If you now select the base object and modify it in either Object or Edit Mode, all changes will also affect the shape of all instanced objects. You can also select the parent mesh to modify the arrangement of the instances; adding vertices will also add more base objects.

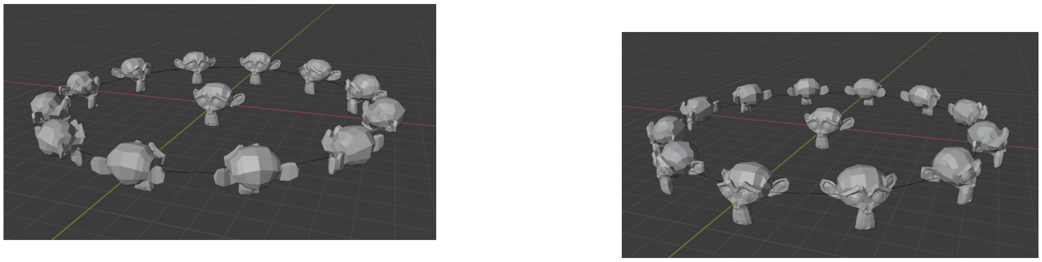
Note that the base objects will inherit changes made to the parent mesh in Object Mode, but not in Edit Mode. So scaling the circle up in Object Mode will enlarge the monkey head, while scaling the circle up in Edit Mode will only increase the distance between the base objects.

Orientation

The orientation of the base objects can be controlled by enabling *Align to Vertex Normal* in the *Instancing* panel. This will rotate all base objects according to the vertex normals of the parent mesh.

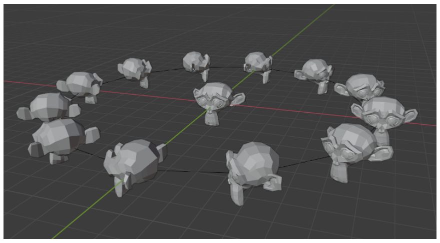
To change the orientation of the instanced objects, select the base object and change the Tracking Axis.

Output of various orientations.

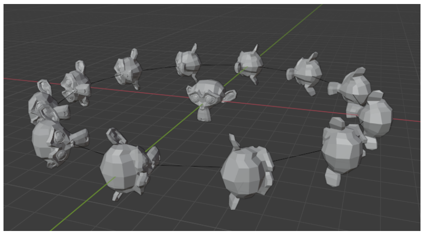


Orientation enabled, orientation +Y.

Negative Y.



Positive X.



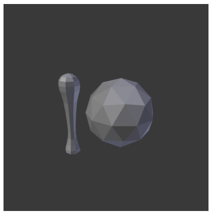
Positive Z, up X.

Note

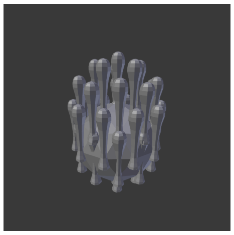
The axes of an object can be made visible in the *Properties* ‣ *Object Properties* ‣ *Viewport Display* panel. To display the vertex normals of the parent mesh, enter *Edit Mode* and enable this visualization in the *Display & Shading* ‣ *Viewport Overlays* ‣ *Normals* where you can also resize the displayed normals as necessary.

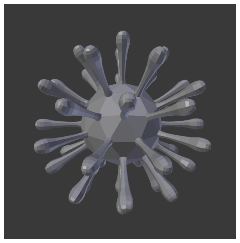
Instanced Vertices as a Modeling Tool

Very interesting models can be made using *Instancing Vertices* and a standard primitive. In this example, a simple tentacle was made by extruding a cube a couple of times. The tentacle object was then parented to an icosphere. With *Align to Vertex Normal* enabled for the parent mesh (the icosphere), the orientation of the base object (the tentacle) was adapted to the vertex normals of the parent mesh (in this case the tentacle was rotated -90° about the X axis in Edit Mode).



A simple tentacle set





to smooth.	Tentacles instanced onto the parent mesh.	*Align to Vertex Normal* enabled to align instanced geometry.

As in the previous example, the shape and proportions of the arrangement can now be tweaked.

To turn all instanced geometry into real objects, select the icosphere and Make Instances Real. To make the icosphere and the tentacle a single object, make sure they are all selected and go to *Object* ▸ *Join*, `Ctrl-J`.

See also

Other duplication methods are listed here.

Faces

Reference

Mode:: Object Mode
Panel:: *Properties ‣ Object Properties ‣ Instancing*

Instancing Faces is the capability to replicate an object on each face of a parent object. One of the best ways to explain this is through an example illustration.

Scale
  Scales each instance according to the size of its corresponding face.

  Inherit Scale
    Scale the instance faces objects.

Make Instance Face tool converts linked objects (that share mesh data) into instanced faces. This tool creates the parent object (instancer) with faces where the objects were, then it uses *Instancing Faces* to put instances at the location of every created face.

You can go back from *Instancing Faces* to multiple linked objects using Make Instances Real.

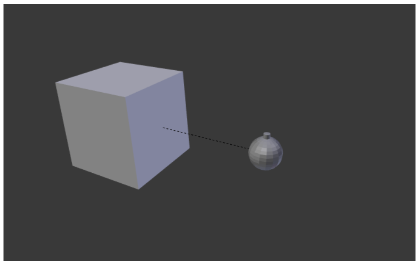
See also

Example blend-file

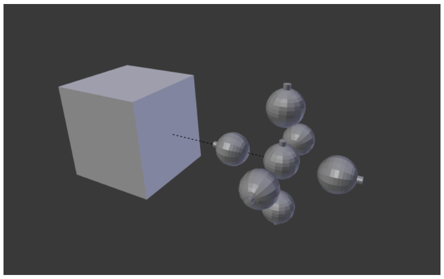
Download the blend-file used for the examples on this page here.

Basic Usage

In this example we will use a UV sphere with an extruded “north pole” as our base object and a cube as our parent mesh. To parent the sphere to the cube, in *Object Mode*, first `LMB` select the sphere, then `Shift-LMB` select the cube (order is very important here), and finally `Ctrl-P` to parent.



A cube and a sphere.



Instancing Faces applied to the cube.

Next, in the *Properties* ‣ *Object Properties* ‣ *Instancing*, select *Faces*. The sphere is instanced, one for each face of the cube.

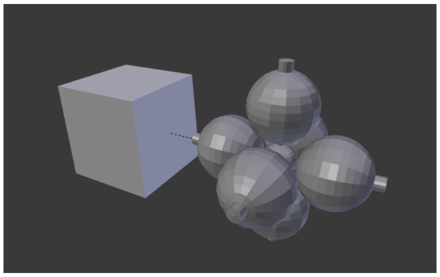
Note

Inherited properties

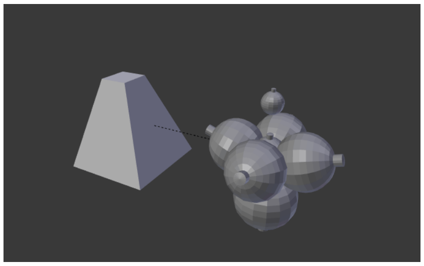
The location, orientation, and scale of the instanced child(ren) matches that of the faces of the parent. So, if several objects are parented to the cube, they will all be instanced once for each face on the cube. If the cube is subdivided, every child will be instanced for each face on the cube.

Both the parent object and original are displayed as editable “templates” in 3D Viewport, but neither is rendered.

Scale



Scale enabled.



Top face of cube scaled down.

By enabling *Scale* for the parent object, the scale of the child objects will be adapted to the size of each face in the parent object.

Thus, by rescaling the face of the parent object, the size of the instanced object will change accordingly.

Limitations/Considerations

The positioning of the instanced geometry relative to the face is dependent upon the position of the child objects relative to the instancer's origin. This can lead to some visual artifacts in the 3D Viewport as the geometry of the original objects overlaps or intersects with the instanced geometry. One workaround is to move the origin of the instancer mesh off of the plane of the faces.

If the geometry of the children is not symmetrical then the orientation of the face (as determined by the order of its vertices) could matter. As of 2.70 Blender does not have tools which allow you to adjust the ordering of the vertices on a face.

However, there is a workflow that lets you control for this. Make a single square and enable the *Instancing Faces* so you can see the instanced geometry in the 3D Viewport. If the orientation is not what you want, rotate the face until it is how you want. Typically you want to do the rotation in Edit Mode, not Object Mode, but this is not a hard rule.

Once you have the orientation correct, Duplicate the face and move the duplicate where you want it. Repeat this process until you have enough faces. Since it is common for these faces to butt up against one another, your geometry will have lots of duplicate vertices. Use the *Merge by Distance* button in the Tools panel.

Demo Video

A short video illustrating this workflow

Collection

Reference

Mode::	Object Mode
Panel::	*Properties* ‣ *Object Properties* ‣ *Instancing* ‣ *Collection*

Instance Collections allows you to create an instance of a collection for each instance of another object. Collections may contain animations, objects with physics simulations and even other nested collections.

Basic Usage

Create a Collection:

- Create a new collection (this can be done via the Outliner).
- Link the objects that need to be instanced as part of the newly created collection.

Create a new Collection Instance:

- *Add* ‣ *Collection Instance*

At this point, an instance of the collection and an empty object will appear. You can duplicate the empty, and the *Instance Collections* settings will be preserved for each empty. This way, you can get multiple copies of linked data very easily.

Collections and Dynamic Linking

See Appending and Linking to understand how to dynamically link data from another blend-file into the current file. You can dynamically link collections from one blend-file to another. When you do so, the linked collection does not appear anywhere in your scene until you create an object controlling where the collection instance appears.

Making an Instanced Collection Real

If you want to make further edits on an instanced collection select the *Instance Collection*. Then call Make Instances Real to convert the collection into regular objects that can be transformed and animated normally.

Note

Note that if the instanced collection was linked from an external file, the Object Data (mesh, materials, textures, transforms) will also still be linked from the original collection. However, the various object's parent-child relationships do not carry over.

Visibility

Reference

Mode:: Object Mode
Panel:: *Properties ‣ Object Properties ‣ Visibility*

The Visibility panel controls how objects are interacted with in the viewport and in the final render. These visibility options can also be set in the Outliner.

Selectable
  The object is able to be selected in the 3D Viewport.

Show In
  Viewports
    The object will be displayed in the 3D Viewport.

  Renders
    The object is able to be in the final render, note that it will still be visible in rendered shading view.

See also

Cycles has additional Visibility properties and also Grease Pencil objects have additional Visibility properties.

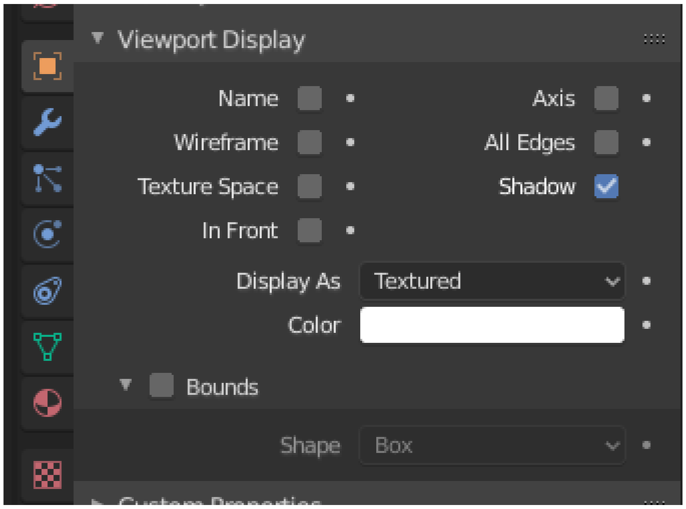
Mask
  Holdout
    Render objects as a holdout or matte, creating a hole in the image with zero Alpha, to fill out in compositing with real footage or another render.

Viewport Display

Reference

Mode:: Object Mode
Panel:: *Properties ‣ Object Properties ‣ Viewport Display*

This panel lets you configure display options for the 3D Viewport.



▾ Viewport Display

Name ☐
Axis ☐
Wireframe ☐
All Edges ☐
Texture Space ☐
Shadow ☑
In Front ☐
Display As: Textured
Color

▾ ☐ Bounds

Shape: Box

Viewport Display panel.

Show

  Name
    Displays the object's name in the 3D Viewport.

  Axes
    Displays an object similar to an empty that shows the object's orientation.

  Wireframe
    Displays the object's wireframe on top of the solid display.

  All Edges

Displays all wireframe edges. This overrides the wireframe threshold that you can set in the 3D Viewport's overlay settings.

Texture Space

Displays the object's Texture Space.

Shadow

Allows the object to cast shadows in the viewport.

In Front

Makes the object display in front of others. Unsupported for instanced objects. Limited support in the *Material Preview* and *Rendered* shading modes (works for e.g. armatures, but not for meshes).

Display As

Lets you display the object with less detail, going from removing the textures to only showing a bounding box. This can be useful if you have a high-poly object that is slowing down the viewport.

Color

The object's color in the *Wireframe* and *Solid* viewport shading modes. Used when the viewport's (Wire) Color shading option is set to *Object*.

Bounds

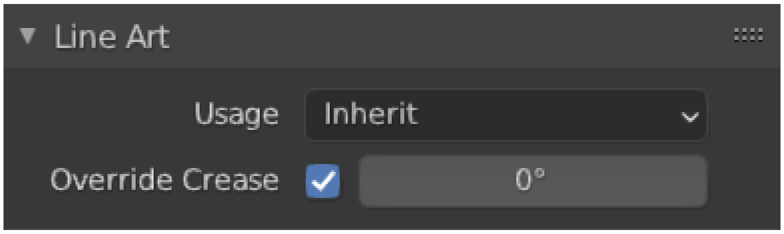
Displays a bounding shape around an object. You can choose between different primitive shapes that might be closer to what the original object looks like.

Line Art

Reference

Mode::	Object Mode
Panel::	*Properties* ▸ *Object Properties* ▸ *Line Art*

The *Line Art* panel is used to enable extra display options for customizing line art rendering for a specific object.



Usage: Inherit

Override Crease ☑ 0°

Line Art panel.

Usage

How the object is loaded into line art. This property overrides the parent collection's Line Art usage.

Inherit::	No special loading strategy for line art. Loading of the object is controlled by parent collection's line art settings.
Include::	Force include the object into line art calculation even if its parent collection specifies otherwise.
Intersection Only::	The object will only produce intersection lines in the scene and its own geometry stays invisible.
Occlusion Only::	The object will only cause occlusion to existing feature lines and its geometry stays invisible.
Exclude::	The object will not be loaded into line art at all.
No Intersection::	The object will not generate intersection lines on itself or with other objects in scene.
Force Intersection::	

Generate intersection lines even with objects that disabled intersection.

Override Crease

Allows the object to have a different crease value than the global one set in the line art modifier.

Crease

Override crease value for the object.

Intersection Priority

Assigns an intersection priority value for this object. The intersection line will be included into the object with the higher intersection priority value.

Tools

- Toolbar
- Tool Settings
  - Options

Types

- Scale Cage

Toolbar

Tweak
Select or move.

Select Box
Select objects by dragging a box. All objects that intersect the box will be selected.

Select Circle
Select objects by dragging a circle. All objects that intersect the path of the circle will be selected.

Select Lasso
Select objects by drawing a lasso.

Cursor
Change the location of the 3D Cursor.

Move
Translation tool.

Rotate
Rotation tool.

Scale
Scale tool.

Scale Cage
Change the scale of an object by controlling its cage.

Transform
Tool to adjust the objects translation, rotations and scale.

Annotate

Draw free-hand annotation.

Annotate Line

Draw straight line annotation.

Annotate Polygon

Draw a polygon annotation.

Annotate Eraser

Erase previous drawn annotations.

Measure

Measure distances in the scene.

Add Cube

Interactively add a cube mesh object.

Add Cone

Interactively add a cone mesh object.

Add Cylinder

Interactively add a cylinder mesh object.

Add UV Sphere

Interactively add a UV sphere mesh object.

Add Icosphere

Interactively add an icosphere mesh object.

Tool Settings

Options

Reference

Mode:: Object Mode and Pose Mode

Header:: *Sidebar ‣ Tool ‣ Options*

Transform

Affect Only

Origins `Ctrl-Period`

Directly transforms the object's origin. This only works for objects with data which can be transformed; i.e. it will not work on object lights.

When enabled, the object axes are displayed.

Take care using this option since it transforms the object-data which may cause linked duplicates to be moved unintentionally.

Hint

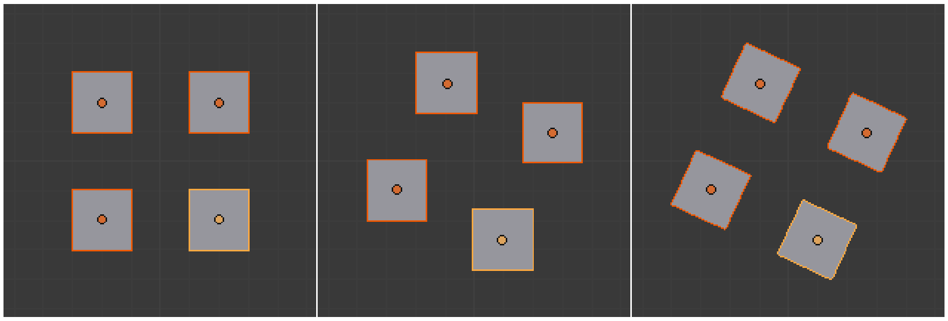
Changing the object location and the object-data may impact modifiers, constraints and keyframe animation.

If you are only temporarily setting the pivot point, use the 3D cursor instead.

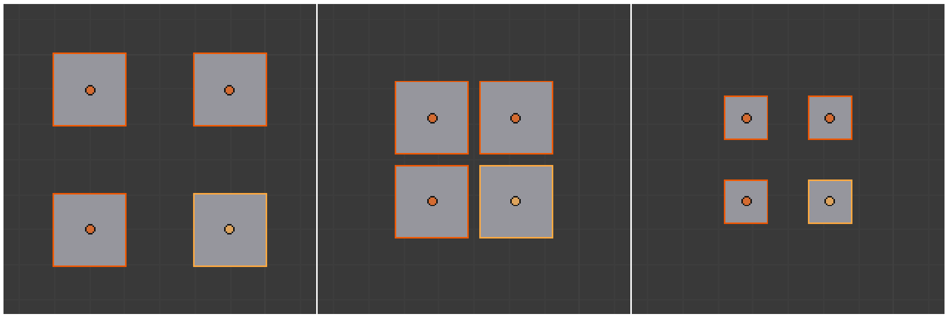
Locations

Changes the position of the object's origin relative to another point during transformation. In other words, the pivot point and the origin cannot share the same location. This will not affect the object local transforms, just its position in world space.

In the examples below, a comparison of the scaling and rotation of objects, when *Location* is enabled (middle) and disabled (right).



Rotation example.



Scaling example.

Parents

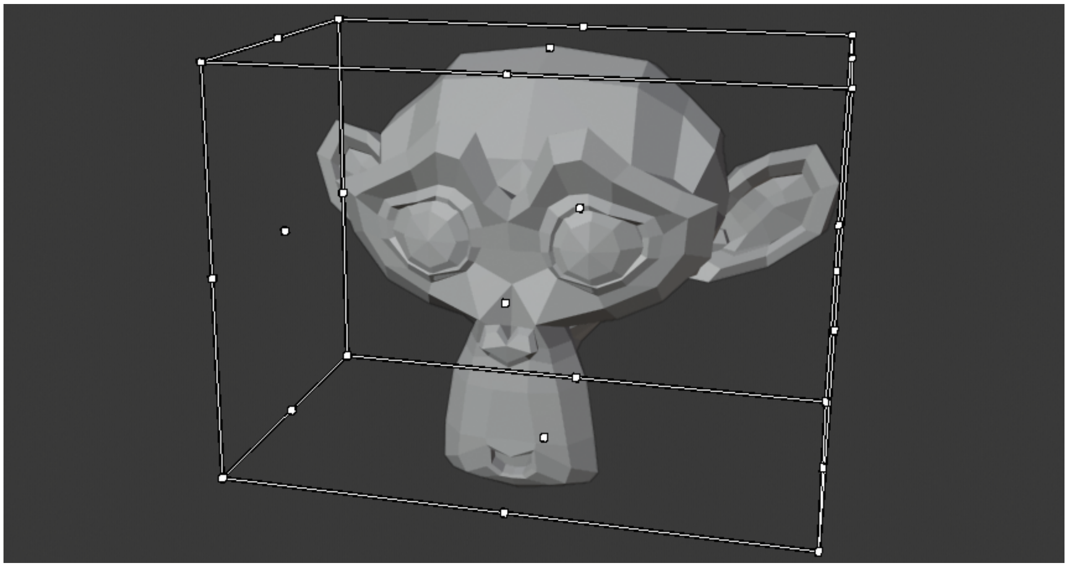
Transforms [Parent Objects]() while leaving their children objects unaffected.

Scale Cage

Reference

Mode:: Object and Edit Modes
Tool:: *Toolbar ‣ Scale ‣ Scale Cage*

The *Scale Cage* tool is a bounding box around the object(s) which scales objects from a particular point or axis. The tool works by selecting a scale point and dragging inwards or outwards to adjust the scale accordingly. The origin for the scale will be from the point on the cube directly opposite from the point selected. Selecting points on the faces of the cube scales along one axis, selecting points on the edges of the cube scales along two axes, and selecting points on the vertices of the cube scales along all three axes.



Scale Cage tool.

Tool Settings

Orientation

Aligns the transformation axes to a specified orientation constraint. See Transform Orientations for more information.

Options

Scale X, Y, Z
: The amount to resize the selection on their respected axis.

Orientation
: Aligns the transformation axes to a specified orientation constraint. See Transform Orientations for more information.

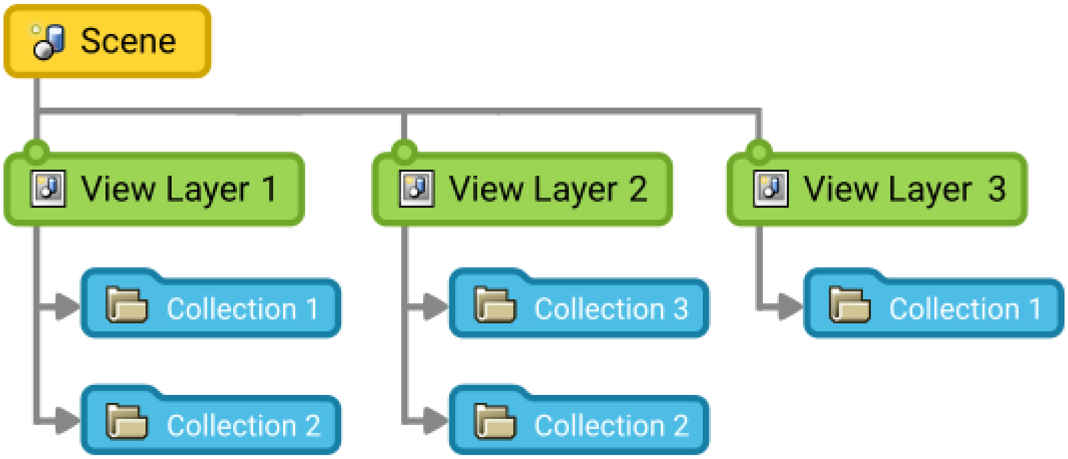
Proportional Editing
: The extruded face will affect nearby geometry. See Proportional Editing for a full reference.

View Layers

- Introduction
    - Outliner

Introduction

The visibility controls are part of *view layers*, designed to help organizing what you want to see or work on.


Scene
View Layer 1
View Layer 2
View Layer 3
Collection 1
Collection 2
Collection 3
Collection 2
Collection 1

View layers and collections.

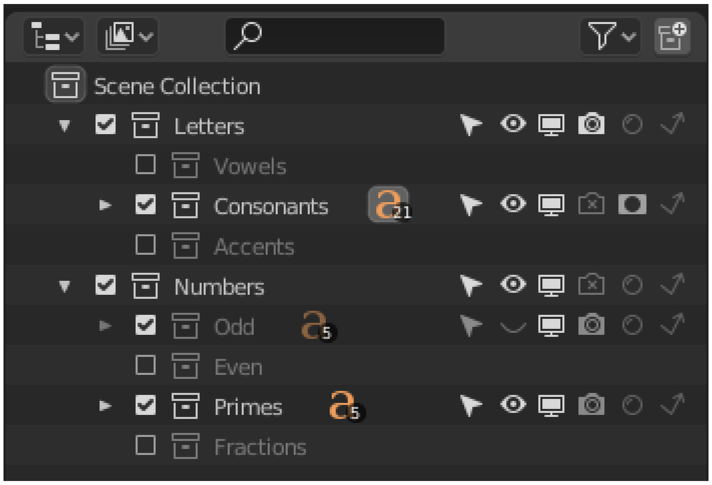
View layers reference to collections, and allow to set their visibility, selectability and other options. A *view layer* can have any collection enabled, and multiple *view layers* can use the same or different collections.

See also

Each view layer can be rendered separately as individual Render Layers to help composite your scene.

Outliner

You can edit the *view layer* collections in the Outliner.


Scene Collection
Letters
Vowels
Consonants
21
Accents
Numbers
Odd
5
Even
Primes
5
Fractions

View layer and collections in the Outliner.

There you can enable and disable collections, hide them temporarily, globally, among other options.

See also

Read more about Collections in the Outliner.

Modeling

- Introduction
    - Modes
- Meshes
    - Introduction
    - Structure
    - Primitives
    - Tools
    - Selecting
    - Editing
    - Properties
    - UVs
    - Mesh Analysis
    - Retopology
- Curves
    - Introduction
    - Tools
    - Structure
    - Primitives
    - Selecting
    - Editing
    - Properties
    - Curve Display
- Curves (New)
    - Tools
    - Primitives
    - Selecting
    - Editing
    - Properties
- Surfaces
    - Introduction
    - Toolbar
    - Structure
    - Primitives

  - Selecting
  - Editing
  - Properties
- Metaball
  - Introduction
  - Toolbar
  - Structure
  - Primitives
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  - Properties
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  - Editing
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  - Introduction
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Introduction

The creation of a 3D scene needs at least three key components: Models, materials and lights. In this part, the first of these is covered, that being modeling. Modeling is simply the art and science of creating a surface that either mimics the shape of a real-world object or expresses your imagination of abstract objects.

Modes

Depending on the type of object you are trying to model, there are different types of modeling modes. Since modes are not specific to modeling they are covered in different parts of the manual.

Switching between modes while modeling is common. Some tools may be available in more than one mode while others may be unique to a particular mode.

Edit Mode

Edit Mode is the main mode where modeling takes place. Edit Mode is used to edit the following types of objects:

- Meshes
- Curves
- Surfaces
- Metaballs
- Text objects
- Lattice

You can only modify the mesh of the objects you are editing. To modify other objects you can leave Edit Mode, select another object and enter Edit Mode, or use Multi-Object Editing.

Meshes

- Introduction
    - Modeling Modes
- Structure
    - Vertices
    - Edges
    - Faces
    - Normals
    - Topology
- Primitives
    - Common Options
    - Plane
    - Cube
    - Circle
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    - Icosphere
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    - Cone
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    - Select Mirror
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    - Checker Deselect
    - Select More/Less
    - Select Similar
    - Select All by Trait
    - Select Linked

  - Select Loops
  - Select Sharp Edges
  - Side of Active
  - By Attribute
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  - Mesh Operators
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  - Edge Operators
  - Face Operators
  - UV Operators
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  - Geometry Data
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  - Sharp Edges
  - Known Limitations
- Retopology
  - Using the Poly Build Tool
  - Remeshing

Introduction

Mesh Modeling typically begins with a Mesh Primitive shape (e.g. circle, cube, cylinder…). From there you might begin editing to create a larger, more complex shape.

Modeling Modes

The 3D Viewport has three principal modes that allow for the creation, editing and manipulation of the mesh models. Each of the three modes has a variety of tools. Some tools may be found in one or more of the modes.

Modes that used for modeling:

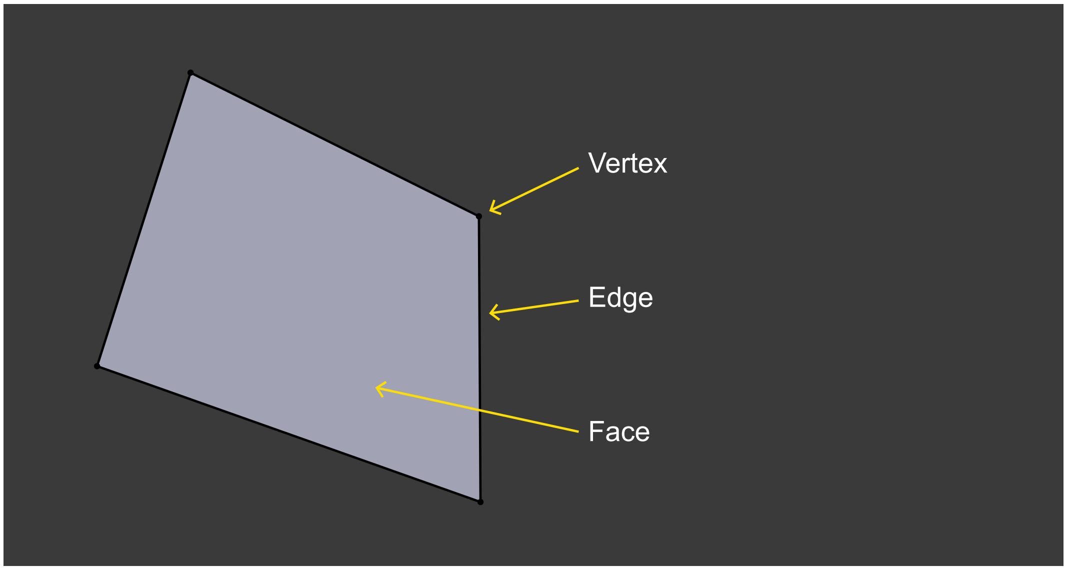
Object Mode
: Supports basic operations such as object creation, joining objects, managing shape keys, UV/color layers.

Edit Mode
: Used for the majority of mesh editing operations.

Sculpt Mode
: Instead of dealing with individual mesh elements, supports sculpting with brushes *(not covered in this chapter)*.

Structure

With meshes, everything is built from three basic structures: *vertices*, *edges* and *faces*.



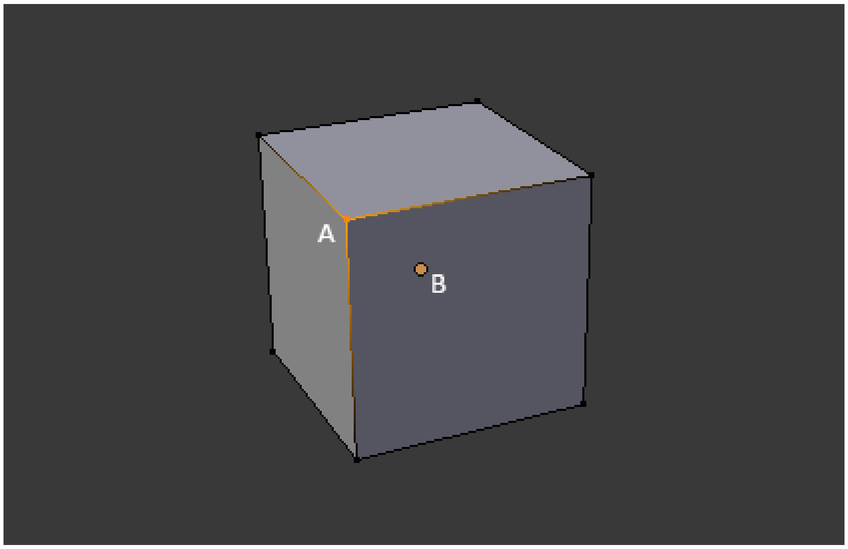
Example of mesh structure.

Vertices

The most elementary part of a mesh is the vertex (vertices plural) which is a single point or position in 3D space. Vertices are represented in the 3D Viewport in Edit Mode as small dots. The vertices of an object are stored as an array of coordinates.

Tip

Do not mistake the object origin for a vertex. It may look similar, but it is bigger and cannot be selected.



The vertex is labeled as “A”; the object’s origin dot is labeled as “B”.

Edges

An edge always connects two vertices by a straight line. The edges are the “wires” you see when you look at a mesh in wireframe view. They are usually invisible on the rendered image. They are used to construct faces.

Faces

Faces are used to build the actual surface of the object. They are what you see when you render the mesh. If this area does not contain a face, it will simply be transparent or nonexistent in the rendered image.

A face is defined as the area between either three (triangles), four (quadrangles) or more (n-gons) vertices, with an edge on every side. The faces are often abbreviated to *tris, quads & n-gons*.

Triangles are always flat and therefore easy to calculate. On the other hand, quadrangles “deform well” and are therefore preferred for animation and subdivision modeling.

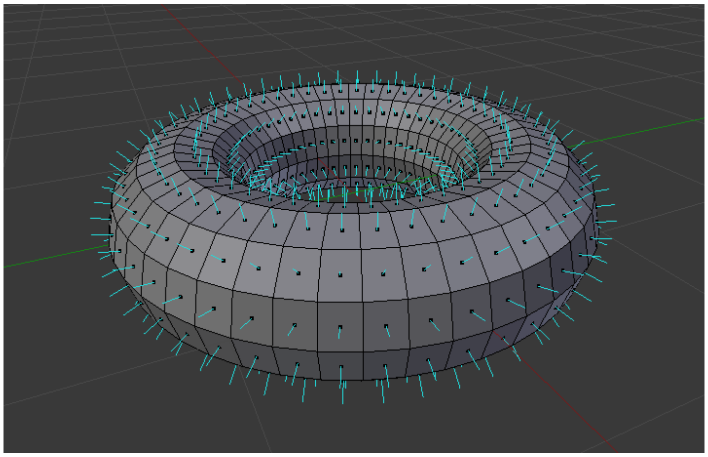
See also

- Why should triangles be avoided for character animation?
- When should N-gons be used, and when shouldn't they?

Normals

In geometry, a normal is a direction or line that is perpendicular to something, typically a triangle or surface but can also be relative to a line, a tangent line for a point on a curve, or a tangent plane for a point on a surface.

Normals help to determine the shading of the mesh among other things.



A visualization of the face normals of a torus.

In the figure above, each blue line represents the normal for a face on the torus. The lines are each perpendicular to the face on which they lie. The visualization can be activated, in Edit Mode, in the Mesh Display Viewport Overlays panel.

Shading

Surface normals play a fundamental role in determining how light interacts with 3D objects and thus greatly influence the shading of those objects.

Normals can be shaded smooth or flat.

When a mesh uses flat shading, the faces are rendered and displayed faces uniformly. This is usually desirable for objects with flat surfaces such as a cube or pyramid.

When a mesh uses smooth shading, the normals are interpolated cross the vertices of a polygonal mesh, smooth transitions between adjacent polygons can be achieved, resulting in a more realistic appearance.

By default face normals have flat shading however, this can be adjusted either for the whole object or per face.

To adjust the the shading of the whole object, use:

- Shade Smooth – To mark the whole object as smooth
- Shade Auto Smooth – To mark portions of the object as smooth

To revert to flat shading, use Shade Flat

The shading of objects can also be adjusted per face, edge, or vertex.

Custom Split Normals

Custom Split Normals is a way to tweak/fake shading by pointing normals towards other directions than the default, auto-computed ones. It is mostly used in game development, where it helps counterbalance some issues generated by low-poly objects (the most common examples are low-poly trees, bushes, grass, etc. and the ‘rounded’ corners).

Blender supports custom normals on a ‘smooth fan’ base, defined as a set of neighbor face corners sharing the same vertex and ‘linked’ by smooth edges. This means you can have normals per face corners, per a set of neighbor face corners, or per vertex.

Tip

The computation of *Custom Split Normals* can be disabled to improve performance. This option can be found in the Simplify Rendering Settings.

Editing Custom Split Normals

Reference

Mode::	Edit Mode
Menu::	*Mesh* ▸ *Normals*
Shortcut::	`Alt-N`

There are a number of tools for editing custom split normals. The custom normal mesh edit tools can affect all normals (the default), or only selected ones. To select a custom normal associated with a particular vertex and face:

- Make the element selection mode both Vertex and Face (use `Shift-LMB` to enable the second one).
- Select one or more vertices, then select a face. This can be repeated to select more vertices and a different face and so on. It is easiest to see the effect of these tools if you turn on the Edit Mode Overlays option *Display vertex-per-face normals as lines*.

See also

Editing Normals.

Importing Custom Split Normals

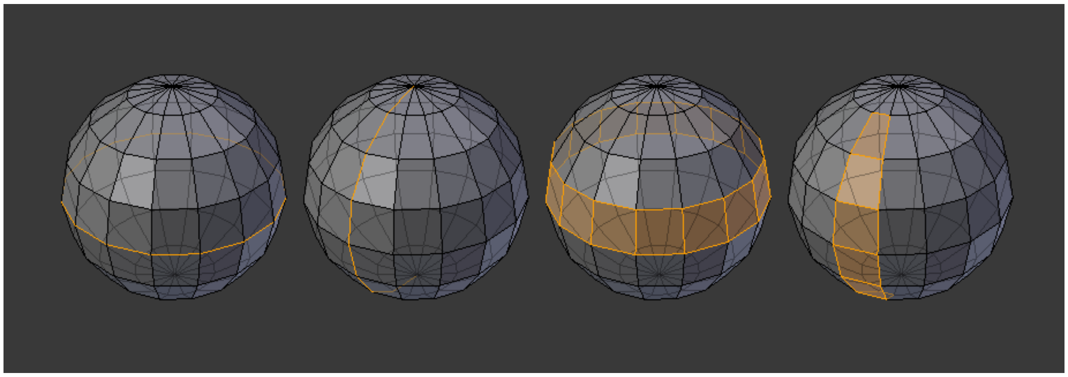
Some tools, particularly those used in CAD, tend to generate irregular geometry when tessellating their objects into meshes (very thin and long triangles, etc.). Auto-computed normals on such geometry often gives bad artifacts, so it is important to be able to import and use the normals as generated by the CAD tool itself.

Note

Currently, only the FBX Importer and Alembic Importer are capable of importing custom normals.

Topology

Loops



Edge and face loops.

Edge and *face* loops are sets of faces or edges that form continuous "loops" as shown in Fig. Edge and face loops..

In the image above, loops that do not end in poles are cyclic (1 and 3). They start and end at the same vertex and divide the model into two partitions. Loops can be a quick and powerful tool to work with specific, continuous regions of a mesh and are a prerequisite for organic character animation. For a detailed description of how to work with loops in Blender, see: Select Edge Loops.

Note

Note that loops (2 and 4) do not go around the whole model. Loops stop at so-called poles because there is no unique way to continue a loop from a pole. Poles are vertices that are connected to either three, five, or more edges. Accordingly, vertices connected to exactly one, two or four edges are not poles.

Edge Loops

Loops (1 and 2) in Fig. Edge and face loops. are edge loops. They connect vertices so that each one on the loop has exactly two neighbors that are not on the loop and placed on both sides of the loop (except the start and end vertex in case of poles).

Edge loops are an important concept especially in organic (subsurface) modeling and character animation. When used correctly, they allow you to build models with relatively few vertices that look very natural when used as subdivision surfaces and deform very well in animation.

Take Fig. Edge and face loops. in organic modeling as an example: the edge loops follow the natural contours and deformation lines of the skin and the underlying muscles. The loops are denser in areas that deform more when the character moves, for example at the shoulders or knees.

Further details on working with edge loops can be found in Select Edge Loops.

Face Loops

These are a logical extension of edge loops in that they consist of the faces between two edge loops, as shown in loops (3 and 4) in Fig. Edge and face loops.. Note that for non-circular loops (4) the faces containing the poles are not included in a face loop.

Further details on working with face loops can be found in Face Loop Selection.

Poles

See N-poles & E-poles.

Non-Manifold

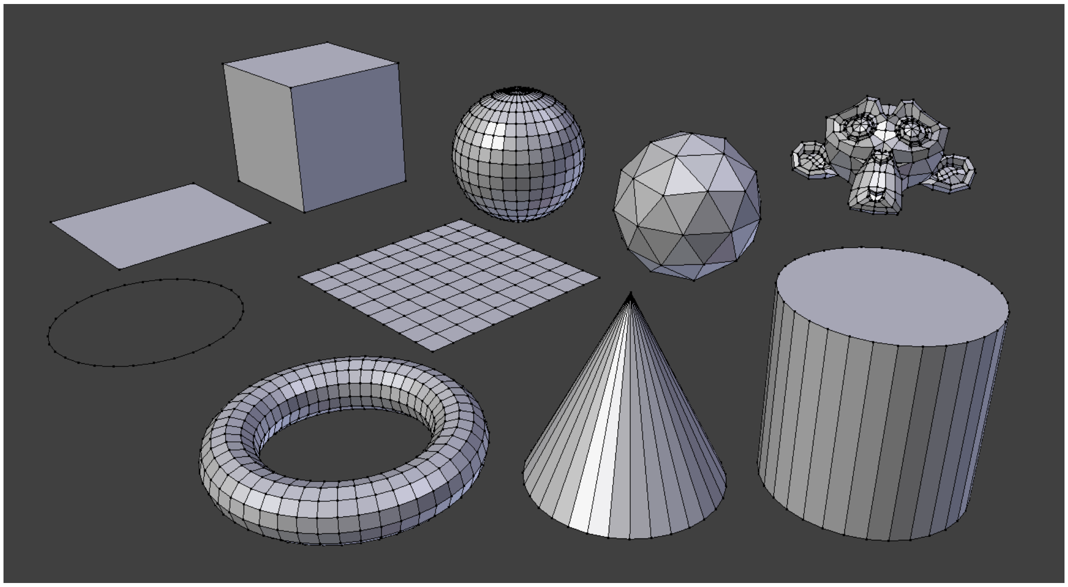
See Non-manifold.

Primitives

Reference

Mode:: Object Mode and Edit Mode
Menu:: *Add ‣ Mesh*
Shortcut:: `Shift-A`

A common object type used in a 3D scene is a mesh. Blender comes with a number of “primitive” mesh shapes that you can start modeling from. You can also add primitives in Edit Mode at the 3D cursor.



Blender’s standard primitives.

Note

Planar Primitives

You can make a planar mesh three-dimensional by moving one or more of the vertices out of its plane (applies to *Plane*, *Circle* and *Grid*). A simple circle is often used as a starting point to create even the most complex of meshes.

Common Options

These options can be specified in the Adjust Last Operation panel, which appears when the object is created. Options included in more than one primitive are:

Generate UVs

Generates a default UV unwrapping of new geometry. This will be defined in the first UV layer (which will get added if needed).

Radius/Size, Align to View, Location, Rotation

See Common Object Options.

Plane

The standard plane is a single quad face, which is composed of four vertices, four edges, and one face. It is like a piece of paper lying on a table; it is not a three-dimensional object because it is flat and has no thickness. Objects that can be created with planes include floors, tabletops, or mirrors.

See also

Import Images as Planes adds a mesh plane with materials and texture from an image file. The dimensions of the plane are calculated to match the aspect of the image file.

Cube

A standard cube contains eight vertices, twelve edges, and six faces, and is a three-dimensional object. Objects that can be created out of cubes include dice, boxes, or crates.

Circle

Vertices

The number of vertices that define the circle or polygon.

Fill Type

Set how the circle will be filled.

Triangle Fan::	Fill with triangular faces which share a vertex in the middle.
N-gon::	Fill with a single N-gon.
Nothing::	Do not fill. Creates only the outer ring of vertices.

UV Sphere

A standard UV sphere is made out of quad faces and a triangle fan at the top and bottom. It can be used for texturing.

Segments

Number of vertical segments. Like the Earth's meridians, going pole to pole.

Rings

Number of horizontal segments. These are like the Earth's parallels.

> **Note**
>
> Rings are face loops and not edge loops, which would be one less.

Icosphere

An icosphere is a polyhedral sphere made up of triangles. Icospheres are normally used to achieve a more isotropical layout of vertices than a UV sphere, in other words, they are uniform in every direction.

Subdivisions
: How many recursions are used to define the sphere. At level 1 the icosphere is an icosahedron, a solid with 20 equilateral triangular faces. Each increase in the number of subdivisions splits each triangular face into four triangles.

Note

Subdividing an icosphere raises the vertex count very quickly even with few iterations (10 times creates 5,242,880 triangles), Adding such a dense mesh is a sure way to cause the program to crash.

Cylinder

Objects that can be created out of cylinders include handles or rods.

Vertices
: The number of vertical edges between the circles used to define the cylinder or prism.

Depth
: Sets the starting height of the cylinder.

Cap Fill Type
: Similar to circle (see above). When set to none, the created object will be a tube. Objects that can be created out of tubes include pipes or drinking glasses (the basic difference between a cylinder and a tube is that the former has closed ends).

Cone

Objects that can be created out of cones include spikes or pointed hats.

Vertices

The number of vertical edges between the circles or tip, used to define the cone or pyramid.

Radius 1

Sets the radius of the circular base of the cone.

Radius 2

Sets the radius of the tip of the cone. Which will create a frustum (a pyramid or cone with the top cut off). A value of 0 will produce a standard cone shape.

Depth

Sets the starting height of the cone.

Base Fill Type

Similar to circle (see above).

Torus

A doughnut-shaped primitive created by rotating a circle around an axis. The overall dimensions can be defined by two methods.

Operator Presets

Torus preset settings for reuse. These presets are stored as scripts in the proper presets directory.

Major Segments

Number of segments for the main ring of the torus. If you think of a torus as a "spin" operation around an axis, this is how many steps are in the spin.

Minor Segments

Number of segments for the minor ring of the torus. This is the number of vertices of each circular segment.

Dimensions Mode

Change the way the torus is defined.

Major/Minor, Exterior/Interior

Major Radius
Radius from the origin to the center of the cross sections.

Minor Radius
Radius of the torus’ cross section.

Exterior Radius
If viewed along the major axis, this is the radius from the center to the outer edge.

Interior Radius
If viewed along the major axis, this is the radius of the hole in the center.

Grid

A regular quadratic grid which is a subdivided plane. Example objects that can be created out of grids include landscapes and organic surfaces.

X Subdivisions
The number of spans in the X axis.

Y Subdivisions
The number of spans in the Y axis.

Monkey

This adds a stylized monkey head to use as a test mesh, use Subdivision Surface for a refined shape.

This is intended as a test mesh, similar to:

- Utah Teapot

- Stanford Bunny.

History

This is a gift from old NaN to the community and is seen as a programmer's joke or "Easter Egg". It creates a monkey's head once you press the *Monkey* button. The Monkey's name is "Suzanne" and is Blender's mascot.

Note

In addition to the basic geometric primitives can be added via extensions These are available from the Preferences.

Import Images as Planes

Reference

Menu:: *3D Viewport ‣ Add ‣ Image ‣ Images as Planes*

Imports images and creates planes with them as textures. It automates the process of creating a plane, resizing it to fit the dimensions of the image, and creating a material with the image texture to it. The name of the plane, material, and texture will be derived from the name of the image file.

You can import a single image, multiple images, or an image sequence/movie clip. If you choose a single image, it creates one plane; if you choose multiple images, it creates as many planes as the number of images you selected, either stacked on top of each other or spaced apart. Selecting a movie clip or an image sequence will create a single plane with an animation.

Properties

You can save the current import settings as an Operator Preset.

Options

Relative Path
: Set link to the image file using a relative file path.

Force Reload
: Reload the image file if it already exists as an image data-block.

Animate Image Sequences
: Import sequentially numbered images as an animated image sequence instead of separate planes. They will be imported as a *Clip* texture on a

single plane. The frame range will be automatically set but can be changed later.

Material

Images as Planes sets up a material to display the image. You can set the type of material and related settings before the import.

Shader

Principled::	The material will have a Principled BSDF shader node with default settings as its main component. An Image Texture node linked to the imported image will be connected to the Base Color of the Principled BSDF node.
Shadeless::	A shadeless material is a material that does not respond to light from other objects and always has the same color in any lighting environment. This option creates a material with a node group of a mix between a Diffuse and an Emission shader controlled by a Light Path node.
Emit::	The material will have a Principled BSDF shader node as its main component, but the Color output from the Image Texture node will be linked to the Emission input instead of the Base Color. Strength Set the strength of the emission.

Note

Blend Mode and *Shadow Mode* options are specific to the EEVEE renderer. For a detailed explanation of each option, see Material Settings.

Blend Mode

Set the alpha blend mode of the material.

Shadow Mode
: Set the shadow mode of the material.

Show Backface
: Show backside of the transparent part.

Backface Culling
: Hide backside of the plane.

Overwrite Material
: By default, the name of the new material from the name of the imported image. However, if there is already a material with the same name, Blender will append a number to the name of the material to avoid conflict. This *Override Material* option makes it overwrite the existing material of the same name in that case.

Texture

Note

For a detailed explanation of each option, see Image Texture Node.

Interpolation
: Set the method to scale the image.

Extension
: Set how the image is extrapolated past the original bounds.

Alpha
: Use the alpha channel of the image for transparency.

Auto Refresh
: Automatically refresh the images in the viewport on frame changes.

Transform

Images as Planes creates the plane at the 3D Cursor’s location. With *Offset Planes*, multiple planes will be placed with distance intervals set in *Offset*, along the axis set in *Local Axis*, beginning at the 3D Cursor’s location.

Size Mode

Set how the plane’s size will be determined.

Absolute:: The size of the plane will be set based on the height value set in *Height*. The width will be set in direct ratio to the height value. For example, with the default height value of 1 m, an image of 800 × 600 pixels will have a width of 1 / 600 × 800 or 1.33 m.

Height

Set the height of the plane.

Camera Relative:: The size of the plane will be set to fit or fill the camera frame. This will automatically set the *Align* option to *Face Camera*. Make sure to have an active camera in the scene before the import.

Fit:: Scale the plane to fit inside the camera frame while preserving the aspect ratio.

Fill:: Scale the plane so that it fills the entire camera view while preserving the aspect ratio, but some part of the image can spill outside the camera frame.

:DPI:

The size of the plane will be set based on the pixels per inch value set in *Definition*. With the *Unit System* set to *Metric* and the default definition of 600 DPI, an image of 800 × 600 pixels will have a size of 0.0339 × 0.0254 units since 600 pixels are defined as 1 inch (0.0254 m).

Definition

Set the number of pixels to fit in 1 inch.

Dots/BU::	The size of the plane will be set based on the pixels per Blender Unit set in *Definition*. With the default definition value of 600, an image of 800 × 600 pixels will have a size of 1.33 × 1 units. Definition Set the number of pixels to fit in 1 Blender Unit.

Align

Set the rotation of the plane.

Main Axis::	The plane will be aligned to a major axis that is best to face the camera's view direction. If there is no camera in the scene, the plane will face toward Z+ (Up) axis.
Face Camera::	Similar to the *Main Axis* but the plane will be rotated to directly face the camera's view direction.
Z- (Down), Y-, X-, Z+ (Up), Y+, X+::	The plane will be rotated to face toward the selected axis.

Track Camera

Add a Locked Track constraint to make the plane always face the camera, even if the camera moves. This option is only available when *Main Axis* or *Face Camera* option is selected in the *Align* menu.

Offset Planes

Place multiple planes with an offset. If disabled, all planes will be created at the same location.

Offset Direction

Choose a local axis (not the global axis) to offset the planes. For example, if you choose *X+*, the planes will be placed along the positive direction of the plane's local X axis.

Distance

Set a distance between each plane.

Tools

- Toolbar
- Tool Settings
    - Options

Types

- Extrude Region
- Extrude Manifold
- Extrude to Cursor
- Loop Cut
- Poly Build
- Spin

Toolbar

Mesh Edit Mode tools:

Select
: Select or move.

  Select Box
  : Select geometry by dragging a box.

  Select Circle
  : Select geometry by dragging a circle.

  Select Lasso
  : Select geometry by drawing a lasso.

Cursor
: Change the location of the 3D Cursor.

Move
: Translation tool.

Rotate
: Rotation tool.

Scale
: Scale tool.

  Scale Cage
  : Change the scale of an object by controlling its cage.

Transform
: Tool to adjust the objects translation, rotations and scale.

Annotate

Draw free-hand annotation.

- Annotate Line
  - Draw straight line annotation.
- Annotate Polygon
  - Draw a polygon annotation.
- Annotate Eraser
  - Erase previous drawn annotations.

Measure

- Measure distances in the scene.

Add Cube

- Interactively add a cube mesh object.
- Add Cone
  - Interactively add a cone mesh object.
- Add Cylinder
  - Interactively add a cylinder mesh object.
- Add UV Sphere
  - Interactively add a UV sphere mesh object.
- Add Icosphere
  - Interactively add an icosphere mesh object.

Extrude Region

- Extrude the selected region together freely or along an axis.
- Extrude Manifold
  - Extrudes region and dissolves overlapping geometry.
- Extrude Along Normals
  - Extrude Region along their local normal.

  - Extrude Individual
    Extrude each individual element along their local normal.

  - Extrude To Cursor
    Extrude selected vertices, edges or faces towards the mouse cursor.

- Inset Faces
  Inset selected faces.

- Bevel
  Create a bevel from the selected elements.

- Loop Cut
  Create a loop cut along the mesh.

  - Offset Edge Loop Cut
    Add two edge loops on either side of selected loops.

- Knife
  Create a knife cut in the mesh. Press enter to confirm the cut.

  - Bisect
    Bisect the mesh.

- Poly Build
  Create geometry by adding vertices one by one.

- Spin
  Create new geometry by extruding and rotating.

- Smooth
  Flatten angles of selected vertices.

  - Randomize
    Randomize selected vertices.

- Edge Slide
  Slide edge along a face.

- Vertex Slide
  - Slide vertex along an edge.

Shrink/Fatten

Move the selected vertices along their normals.

- Push/Pull
  - Move the selected elements away from/towards the pivot point.

Shear

Shear selected elements.

- To Sphere
  - Move vertices outwards in a spherical shape around object center.

Rip Region

Rip Polygons and move the result.

- Rip Edge
  - Extend vertices and move the result.

Tool Settings

Options

Reference

Mode:: Edit Mode
Panel:: *Sidebar ‣ Tool tab ‣ Options panel*

Transform

Correct Face Attributes

Adjust geometry attributes like UVs and Color Attributes while transforming.

Keep Connected

Merge attributes connected to the same vertex while using *Correct Face Attributes*.

Tip

Keeping UVs connected is useful for organic modeling, but not for architectural modeling.

Mirror

Mirror allows you to transform vertices symmetrically according to the chosen axis. When you transform an element (vertex, edge or face), if there is its exact axis-mirrored counterpart (in local space), it will be transformed accordingly, through a symmetry along the chosen axis.

Note

The conditions for *Mirror* to work are quite strict, which can make it difficult to use. To have an exact mirrored version of a (half) mesh, it's easier and simpler to use the Mirror Modifier.

Topology Mirror

Note

For *Topology Mirror* to work, at least one of the three *Mirror Axis* must be enabled.

When using any of the three *Mirror Axis* options to work on a mirrored Mesh Geometry, the vertices that are mirrored must be perfectly placed. If they are not exactly positioned in their mirror locations then the *Mirror Axis* will not treat those vertices as mirrored.

Topology Mirror tries to address this problem by determining which vertices are mirrored vertices not only by using their positions but also by looking at how those vertices are related to others in the Mesh Geometry. It looks at the overall topology to determine if particular vertices will be treated as mirrored. The effect of this is that mirrored vertices can be non-symmetrical and yet still be treated as mirrored.

Note

The *Topology Mirror* functionality will work more reliably on mesh geometry which is more detailed. If you use very simple geometry, for example a *Cube* or *UV Sphere*, the *Topology Mirror* option will often not work.

Example

For an example of how to use *Topology Mirror* open up a new Blender scene, then delete the default cube and add a Monkey object to the 3D Viewport.

1. Press `Tab` to put the Monkey object into *Edit Mode*.
2. With all the *Mirror Axis* options disabled move one of the Monkey object's vertices slightly.
3. Then Turn the *X Axis Mirror* on but leave *Topology Mirror* disabled.
4. If you now move that vertex again, the *X Axis Mirror* will not work and the mirrored vertices will not be altered.
5. If you then enable *Topology Mirror* and move the same vertices again, then *X Axis Mirror* should still mirror the other vertex, even though they are not perfectly positioned.

Auto Merge

Reference

Mode:: Edit Mode
Menu:: *Sidebar ▸ Tool ▸ Options ▸ Auto Merge*

When enabled, as soon as a vertex moves closer to another one than the *Threshold* setting, they are automatically merged. This option affects interactive operations only (tweaks made in the Adjust Last Operation panel are considered interactive too). If the exact spot where a vertex is moved contains more than one vertex, then the merge will be performed between the moved vertex and one of those.

Split Edges & Faces
: Detects the intersection of each transformed edge, creating a new vertex in place and sectioning the edge and the face if any.

Threshold
: Defines the maximum distance between vertices that are merged.

UVs

Live Unwrap

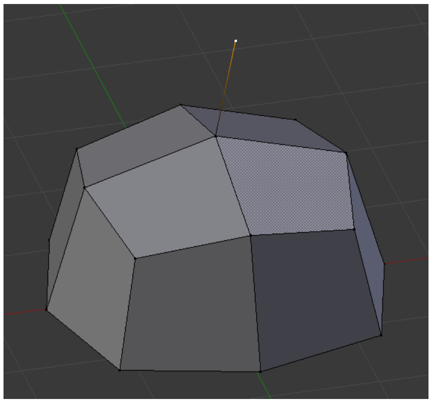
Automatically recalculates the UV unwrapping every time an edge has its seam property changed. Note, this is different than the Live Unwrap option in the UV Editor.

Extrude Region

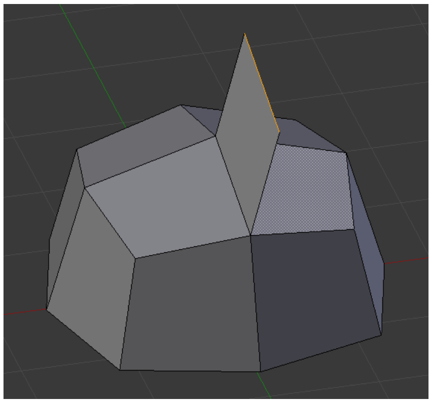
Reference

Mode::	Edit Mode
Tool::	*Toolbar ‣ Extrude Region*
Shortcut::	`E`

Extrusion tools duplicate vertices, while keeping the new geometry connected with the original vertices. Vertices are turned into edges and edges will form faces.



Single vertex extruded.



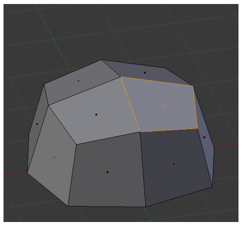
Single edge extruded.

This tool is of paramount importance for creating new geometry. It allows you to create parallelepipeds from rectangles and cylinders from circles, as well as easily creating such things as tree limbs.

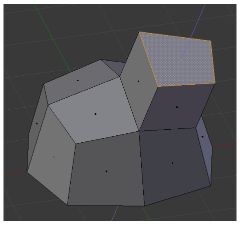
The axis on which vertices and edges are extruded along can be set interactively. Faces are extruded by default along their averaged normal. The extrusion can be limited to a single axis by specifying an axis; see Axis Locking.

The extrude tools differentiate in how the new geometry is connected in itself.

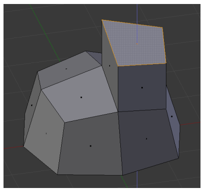
Only the border loop gets extruded. The inner region of the selection gets moved unchanged with the extrusion.



Selected face.



During extrude.



Set to Z axis.

Details

Although the process is quite intuitive, the principles behind *Extrude* are fairly elaborate as discussed below:

- First, the algorithm determines the outside edge loop of the extrude; that is, which among the selected edges will be changed into faces. By default (see below), the algorithm considers edges belonging to two or more selected faces as internal, and hence not part of the loop.
- The edges in the edge loop are then changed into faces.
- If the edges in the edge loop belong to only one face in the complete mesh, then all of the selected faces are duplicated and linked to the newly created faces. For example, rectangles will result in parallelepipeds during this stage.
- In other cases, the selected faces are linked to the newly created faces but not duplicated. This prevents undesired faces from being retained “inside” the resulting mesh. This distinction is extremely important since it ensures the construction of consistently coherent, closed volumes at all times when using *Extrude*.

- When extruding completely closed volumes (like e.g. a cube with all its six faces), extrusion results merely in a duplication, as the volume is duplicated, without any link to the original one.
- Edges not belonging to selected faces, which form an “open” edge loop, are duplicated and a new face is created between the new edge and the original one.
- Single selected vertices which do not belong to selected edges are duplicated and a new edge is created between the two.

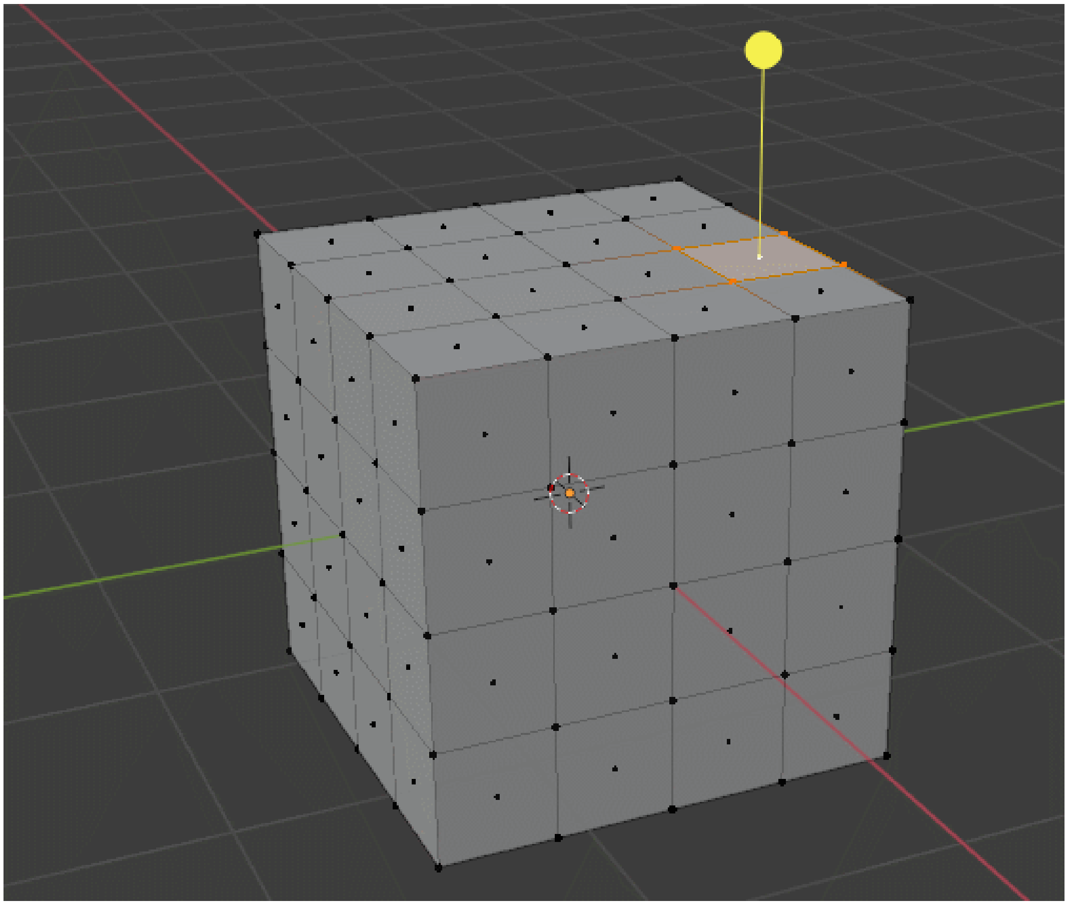
Extrude Manifold

Reference

Mode::	Edit Mode
Tool::	*Toolbar* ‣ *Extrude Manifold*
Menu::	*Mesh* ‣ *Extrude* ‣ *Extrude Manifold*

This tool is very similar to Extrude Faces but enables *Dissolve Orthogonal Edges* by default. This causes the tool to automatically split and remove adjacent faces when extruding inwards.

Example



Extrude Manifold Example.

Extrude to Cursor

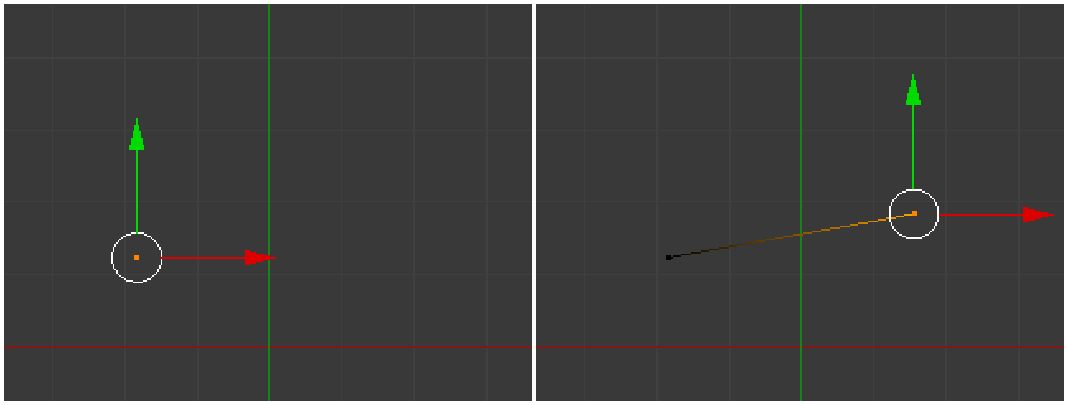
Reference

Mode:: Edit Mode
Shortcut:: `Ctrl-RMB`

Interactively places new vertices with `Ctrl-RMB` at the mouse cursor position.

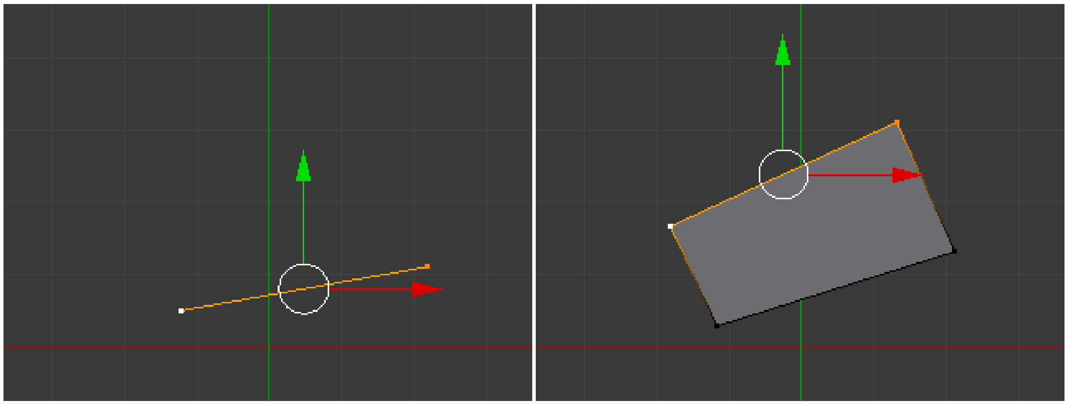
The most basic element, a vertex, can be added with a `Ctrl-RMB` click when no other vertices are selected. Because the camera space (computer screen) is two-dimensional, Blender cannot determine all three vertex coordinates from a single mouse click, so the new vertex is placed at the depth of the 3D cursor.

To create interconnected vertices, you can add a vertex and continuously make subsequent `Ctrl-RMB` operations with the last vertex selected. This will link the last selected vertex with the vertex created at the mouse position with an edge (see Fig. Adding vertices one by one.), and will continuously create and connect new vertices if you continue repeating this operation.



Adding vertices one by one.

Creating Faces



Quad from an Edge with source automatically rotated.

If you have two vertices selected and already connected with an edge, `Ctrl-RMB` click will create a planar face, also known as a quad. Blender will follow your mouse cursor and will use the planar view from your viewport to create those quads.

For `Ctrl-RMB`, Blender will automatically rotate the last selected Edge (the source) for the subsequent operations if you have at least one face created, dividing the angles created between the newly created edge and the last two edges, creating a smooth angle between them. Blender will calculate this angle using the last positive and negative position of the last X and Y coordinates and the last connected unselected edge. If this angle exceeds a negative limit (following a quadrant rule) between the recently created edge and the last two, Blender will wrap the faces. But if you do not want Blender to rotate and smooth edges automatically when extruding from `Ctrl-RMB`, you can also inhibit Blender from rotating sources using the shortcut `Shift-Ctrl-RMB`. In this case, Blender will not rotate the source dividing the angle between those edges when creating a face.

If you have three or more vertices selected, and `Ctrl-RMB` click, you will also create planar faces, but along the vertices selected, following the direction of the cursor. This operation is similar to an extrude operation.

Tip

When adding objects with `Ctrl-RMB`, the extrusions of the selected elements, being vertices, edges and faces with the `Ctrl-RMB`, are viewport dependent. This means, once you change your viewport, for example, from top to left, bottom or right, the extrusion direction will also follow your viewport and align the extrusions with your planar view.

Loop Cut

Reference

Mode:: Edit Mode
Tool:: *Toolbar* ‣ *Loop Cut*
Shortcut:: `Ctrl-R`

The *Loop Cut* tool is a modal tool version of the Loop Cut and Slide operator. This tool splits a loop of faces by inserting new edge loops intersecting the chosen edge.

Usage

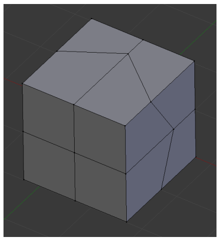
The tool is interactive and has two steps:

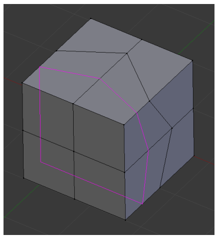
1. Pre-Visualizing the Cut

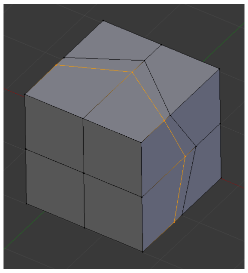
   After the tool is activated, move the cursor over a desired edge. The cut to be made is marked with a magenta colored line as you move the mouse over the various edges. The to be created edge loop stops at the poles (tris and n-gons) where the existing face loop terminates.

2. Perform the Cut

   Once the desired location of the new edge loop is found, the edge loop can be created via `LMB`.







Mesh before inserting edge loop.

Preview of edge loop location.

Interactive placement of edge loop between adjacent loops.

Tool Settings

Number of Cuts

Increases and decreases the number of cuts to create. These cuts are uniformly distributed in the original face loop, and you will *not* be able to control their positions.

Correct UVs

Corrects the corresponding UV coordinates, if these exist, to avoid image distortions.

Options

After the modal tool is run the Loop Cut and Slide Options are available in the Adjust Last Operation panel.

Poly Build

Reference

Mode::	Edit Mode
Tool::	*Toolbar ‣ Poly Build*

Poly Build combines several mesh editing tools into one, letting you work more quickly. It's especially useful for retopology.

Tool Settings

Create Quads
: When creating a new triangle that shares an edge with an existing one, automatically dissolves this edge so you're left with a quad.

Controls

Adding Geometry `Ctrl-LMB`
: Creates a new vertex at the mouse cursor, then creates a triangle using this new vertex and the nearest existing edge. If the existing edge already has two neighboring faces, instead creates a new edge using the new vertex and the nearest existing vertex. Holding `Ctrl` will preview the result in blue.

Deleting Geometry `Shift-LMB`
: Dissolves the vertex/deletes the face under the mouse cursor. Holding `Shift` will highlight the target element in red.

Moving Vertices `LMB`
: You can move a vertex by dragging it.

Extruding Edges `LMB`
: You can extrude an edge into a quad by dragging it.

Tip

It is useful to enable Snapping and Auto Merge while tweaking vertices to combine them.

Spin

Reference

Mode::	Edit Mode
Menu::	*Mesh ‣ Extrude ‣ Spin*
Tool::	*Toolbar ‣ Spin*

The *Spin* tool extrudes (or duplicates it if the selection is manifold) the selected elements, rotating around a specific point and axis.

Use the tool to create the sort of objects that you would produce on a lathe (this tool is often called “lathe” tool or “sweep” tool in the literature, for this reason). In fact, it does a sort of circular extrusion of your selected elements, centered on the 3D cursor, and around the axis perpendicular to the working view…

- The point of view will determine around which axis the extrusion spins…
- The position of the 3D cursor will be the center of the rotation.

Tool Settings

Steps
: Specifies how many copies will be extruded along the “sweep”.

Use Duplicates
: When enabled, will keep the original selected elements as separated islands in the mesh (i.e. unlinked to the result of the spin extrusion).

Axis
: Specifies the axis to use as the pivot of the spin operation.

Options

Steps

Specifies how many copies will be extruded along the “sweep”.

Angle

Specifies the angle “swept” by this tool, in degrees (e.g. set it to 180 for half a turn).

Auto Merge

Automatically merges the first a last duplicates, if they make a full revolution which results in overlapping geometry.

Flip Normals

Reverses the Normal’s direction for any resulting geometry.

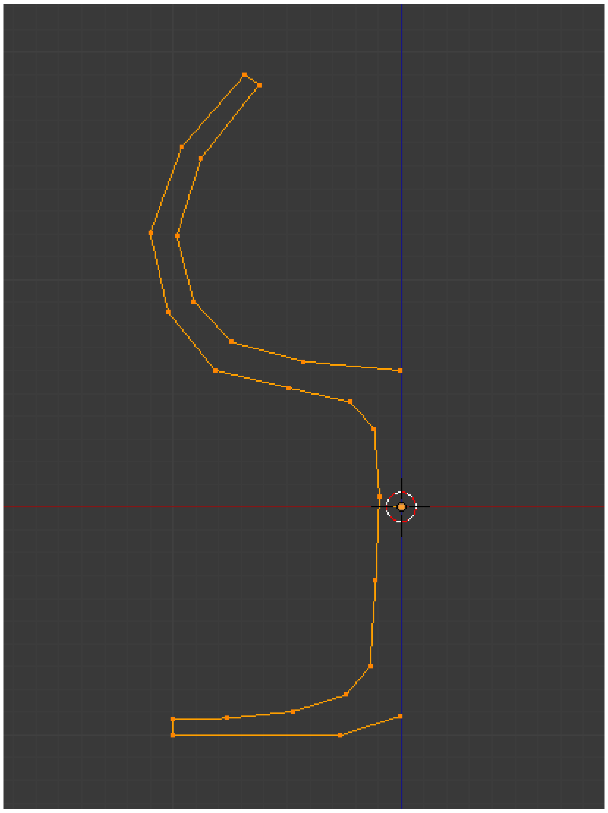
Center X, Y, Z

Specifies the center of the spin. By default it uses the cursor position.

Axis X, Y, Z

Specify the spin axis as a vector. By default it uses the view axis (viewport).

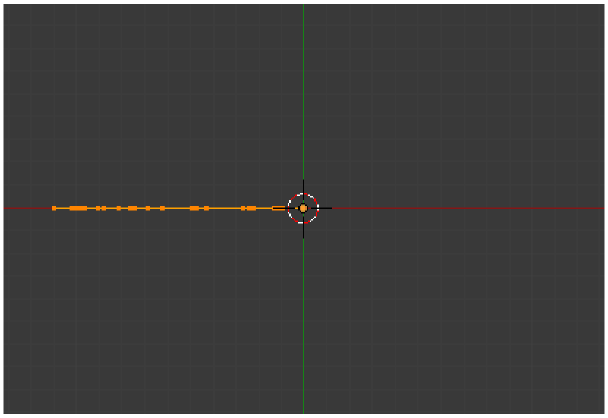
Example



Glass profile.

First, create a mesh representing the profile of your object. If you are modeling a hollow object, it is a good idea to thicken the outline. Fig. Glass profile. shows the profile for a wine glass we will model as a demonstration.

We will be rotating the object around the cursor in the top view, so switch to the top view with `Numpad7`.



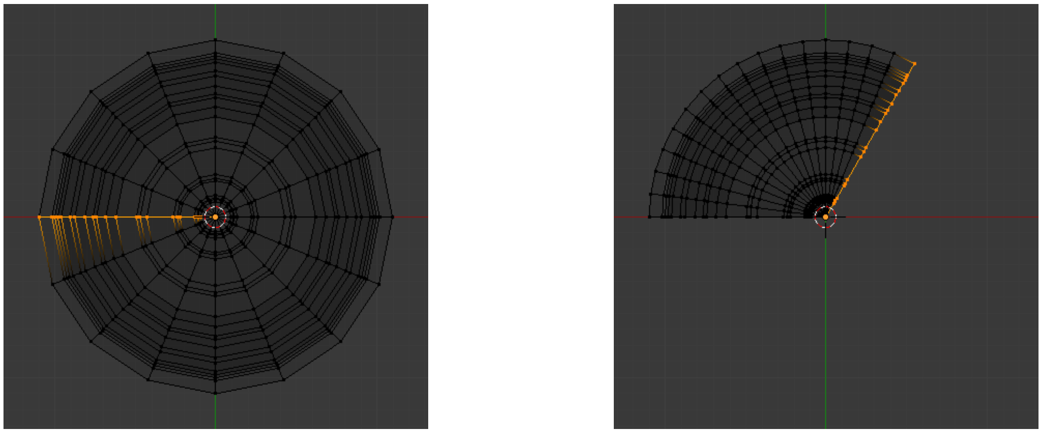
Glass profile, top view in Edit Mode, just before spinning.

Place the cursor along the center of the profile by entering Edit Mode and selecting one of the vertices along the center, and snapping the 3D cursor to that location with *Mesh ‣ Snap ‣ Cursor to Selection*. (Fig. Glass profile, top view in Edit Mode, just before spinning.) shows the wine glass profile from top view, with the cursor correctly positioned.

Select all the vertices with `A` and select the *Spin* tool from the Toolbar and use the Gizmo to spin the vertices. Fig. Spun profile. shows the result of a successful spin.

Angle

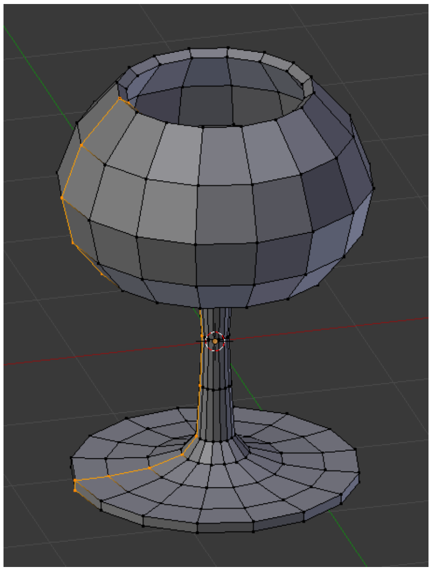
Spun profile.



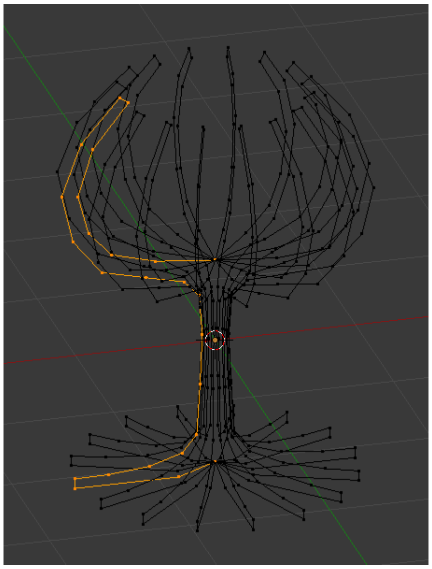
Spun profile using an angle of 360.

Spun profile using an angle of 120.

Duplicate

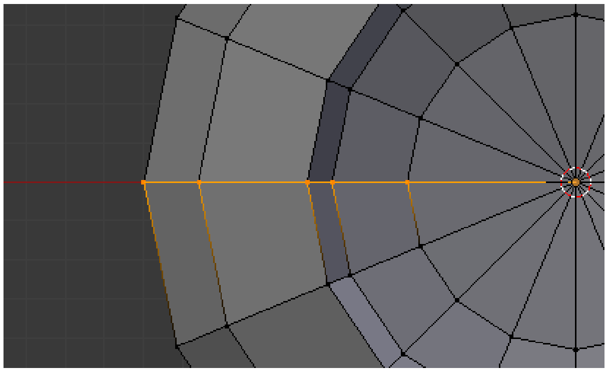


Result of spin operation.



Result of *Duplicate* enabled.

Merge Duplicates



Duplicate vertices.

The spin operation leaves duplicate vertices along the profile. You can select all vertices at the seam with Box select `B` (shown in Fig. Duplicate vertices.) and perform a *Merge by Distance* operation.

Notice the selected vertex count before and after the *Merge by Distance* operation `Vertex count after removing doubles`. If all goes well, the final vertex count (38 in this example) should match the number of the original profile noted in *Mesh data ‣ Vertex and face numbers*. If not, some vertices were missed and you will need to weld them manually. Or, worse, too many vertices will have been merged.

Note

Merging Two Vertices into One

To merge (weld) two vertices together, select both of them by `Shift-LMB` clicking on them. Press `S` to start scaling and hold down `Ctrl` while scaling to scale the points down to 0 units in the X, Y and Z axis. `LMB` to complete the scaling operation and click *Mesh ‣ Merge ‣ By Distance* to merge the vertices. Alternatively, you can use *Context Menu ‣ Merge Vertices* (or `M`). Then, in the new pop-up menu, choose to merge *By Distance*.

Recalculate Normals

All that remains now is to recalculate the normals to the outside by selecting all vertices, pressing `Alt-N` and validating *Recalculate Normals Outside* in the pop-up menu.

Selecting

- Introduction
  - Selection Modes
  - X-Ray
  - Select Menu
  - Known Issues
- Select Mirror
  - Example
- Select Random
- Checker Deselect
- Select More/Less
  - Select Next/Previous Active
- Select Similar
  - Face Regions
- Select All by Trait
  - Non-Manifold
  - Loose Geometry
  - Interior Faces
  - Faces by Sides
  - Ungrouped Vertices
- Select Linked
  - Linked
  - Shortest Path
  - Linked Flat Faces
- Select Loops
  - Select Edge Loops
  - Select Face Loops
  - Select Edge Rings
  - Select Loop Inner-Region
  - Select Boundary Loop
- Select Sharp Edges
- Side of Active
- By Attribute
  - Usage

Introduction

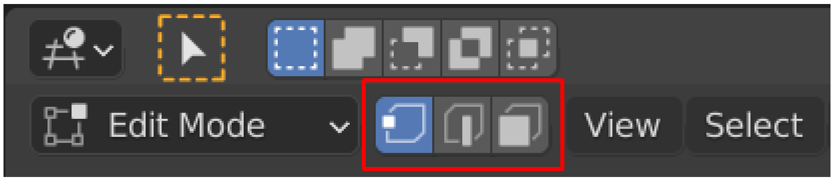
There are many ways to select elements, and it depends on what *Mesh Select Mode* you are in as to what selection tools are available. First we will go through these modes and after that a look is taken at basic selection tools.

Selection Modes

Reference

Mode:: Edit Mode
Menu:: *3D Viewport Header ‣ Select Mode*
Shortcut:: `1`, `2`, `3` (`Shift` Multiple Selection Modes, `Ctrl` Expand/Contract Selection).

In *Edit Mode* there are three different selection modes. You can enter the different modes by selecting one of the three buttons in the header.



Edit Mode selection buttons from right to left: Vertex, Edge, Face.

Vertex
: In this mode vertices are shown as points. Selected vertices are displayed in orange, unselected vertices in black, and the active or last selected vertex in white.

Edge
: In this mode the vertices are not shown. Instead the selected edges are displayed in orange, unselected edges black, and the active or last

selected edge in white.

Face

In this mode the faces are displayed with a selection point in the middle which is used for selecting a face. Selected faces and their selection point are displayed in orange, unselected faces are displayed in black, and the active or last selected face is highlighted in white.

When using these buttons, you can make use of modifier keys, see: Switching Select Mode.

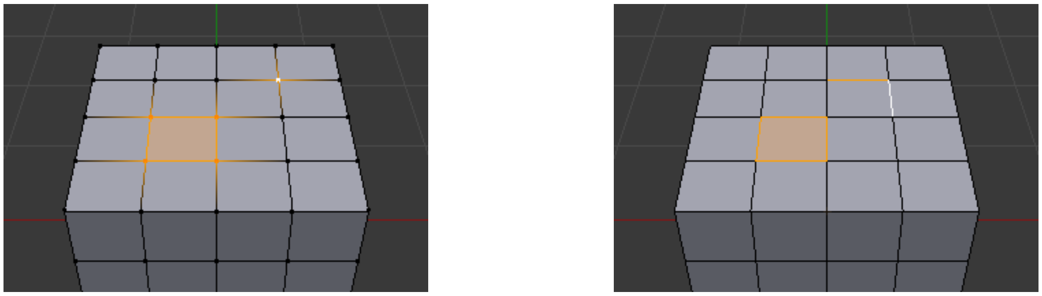
Almost all tools are available in all three mesh selection modes. So you can *Rotate*, *Scale*, *Extrude*, etc. in all modes. Of course rotating and scaling a *single* vertex will not do anything useful (*without* setting the pivot point to another location), so some tools are more or less applicable in some modes.

See Fig. Selection modes. for examples of the different modes.

Multiple Selection Modes

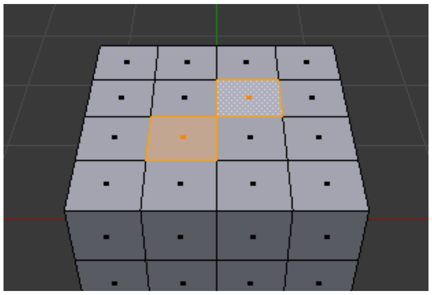
By holding `Shift-LMB` when selecting a selection mode, you can enable multiple *Selection Modes* at once. This allows you to quickly select vertices, edges, or faces, without first having to switch mode.

Selection modes.

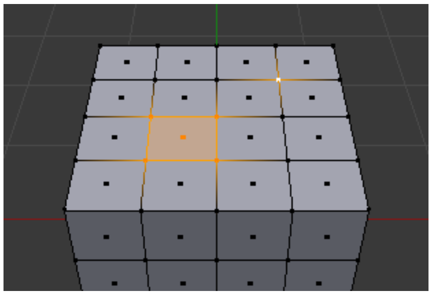


Vertex mode example.

Edge mode example.



Face mode example.

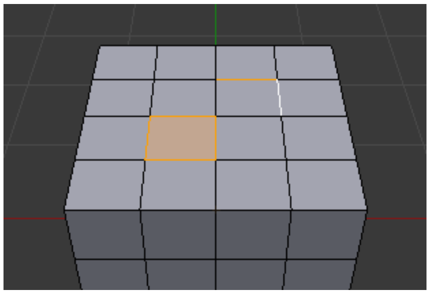


Mixed mode example.

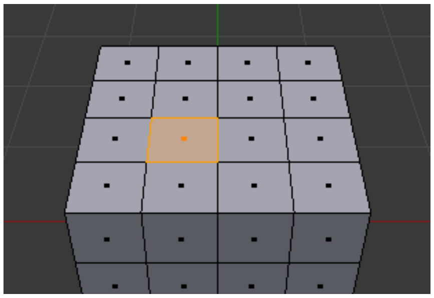
Switching Select Mode

When switching modes in an “ascendant” way (i.e. from simpler to more complex), from *Vertices* to *Edges* and from *Edges* to *Faces*, the selected parts will still be selected if they form a complete element in the new mode.

For example, if all four edges in a face are selected, switching from *Edges* mode to *Faces* mode will keep the face selected. All selected parts that do not form a complete set in the new mode will be unselected.



Edge mode, the initial selection.

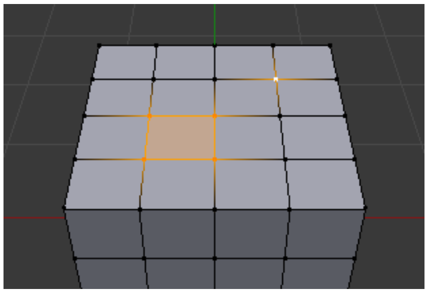


Switching to Face mode.

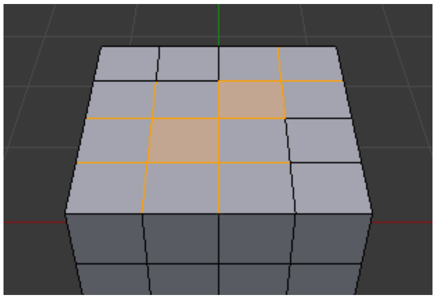
Hence, switching in a “descendant” way (i.e. from more complex to simpler), all elements defining the “high-level” element (like a face) will be selected (the four vertices or edges of a quadrangle, for example).

Expand/Contract Selection

By holding `Ctrl` when selecting a higher selection mode, all elements touching the current selection will be added, even if the selection does not form a complete higher element. Or contracting the selection when switching to a lower mode.



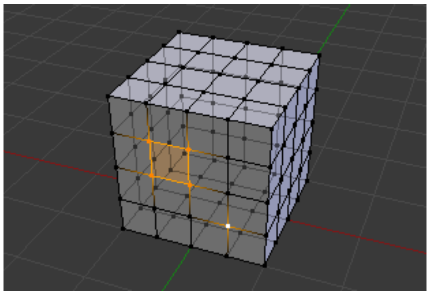
Vertex mode, the initial selection.



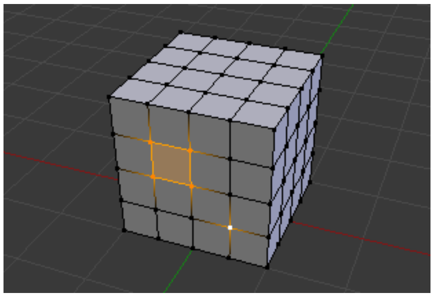
Expanding to Edge mode.

X-Ray

The X-Ray setting is not just for shading, it impacts selection too. When enabled, selection isn't occluded by the objects geometry (as if the object was solid).



X-ray enabled.



X-ray disabled.

Select Menu

All `A`

Select all.

None `Alt-A`

Select none.

Invert `Ctrl-I`

Selects all the geometry that is not selected, and deselect currently selected components.

Box Select `B`

Interactive box selection.

Circle Select `C`

Interactive circle selection.

Lasso Select

Interactive free-form selection.

Select Mirror `Shift-Ctrl-M`

Select mesh items at the mirrored location across the chosen axis.

Select Random

Selects a random group of vertices, edges, or faces, based on a percentage value.

Checker Deselect

Deselect alternate elements relative to the active item.

More/Less

More `Ctrl-NumpadPlus`

Expands the selection to the adjacent elements of the selection type.

Less `Ctrl-NumpadMinus`
Contracts the selection from the adjacent elements of the selection type.

Next Active `Shift-Ctrl-NumpadPlus`
This uses selection history to select the next vertex, edge, or face based on surrounding topology.

Previous Active `Shift-Ctrl-NumpadMinus`
Select previous just removes the last selected element.

Select Similar `Shift-G`
Select elements similar to the current selection.

Select All by Trait
Select geometry by querying its characteristics.

Select Linked

- Select Linked
  Selects all components that are connected to the current selection.

- Shortest Path
  Path between two selected elements.

- Linked Flat Faces
  Select connected faces based on a threshold of the angle between them. This is useful for selecting faces that are planar.

Select Loops

- Edge Loops
  Select connected edges.

- Face Loops
  Select connected faces.

- Edge Rings
  Select connected edge ring.

Sharp Edges

This tool selects all edges between two faces forming an angle greater than the angle value, where an increasing angle selects sharper edges.

Side of Active

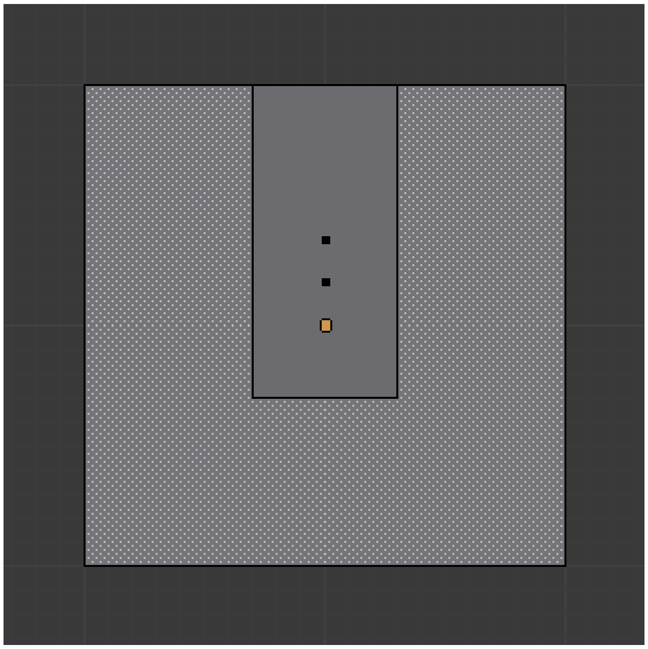
Selects all vertices on the mesh in a single axis relative to the active vertex. In Vertex selection mode only.

Known Issues

Dense Meshes

Selecting dense meshes with X-Ray disabled, has a limitation where dense meshes may not have all the elements selected. When selecting regions with Box, Circle and Lasso select, vertices may overlap each other causing some vertices not to be selected. This is a limitation with the current selection method, you may workaround this by zooming in or enabling X-Ray.

N-Gons in Face Select Mode



N-gon face having its center dot inside another face.

As already noted, in X-Ray and Wireframe mode faces are marked with a dot in the middle. With n-gons that can lead in certain cases to a confusing display. The example shows the center dot of the U-shaped n-gon being inside of the oblong face inside the “U”. It is not easy to identify which dot belongs to which face (the orange dot in the image is the object origin).

Select Mirror

Reference

Mode:: Edit Mode
Menu:: *Select ‣ Select Mirror*
Shortcut:: `Shift-Ctrl-M`

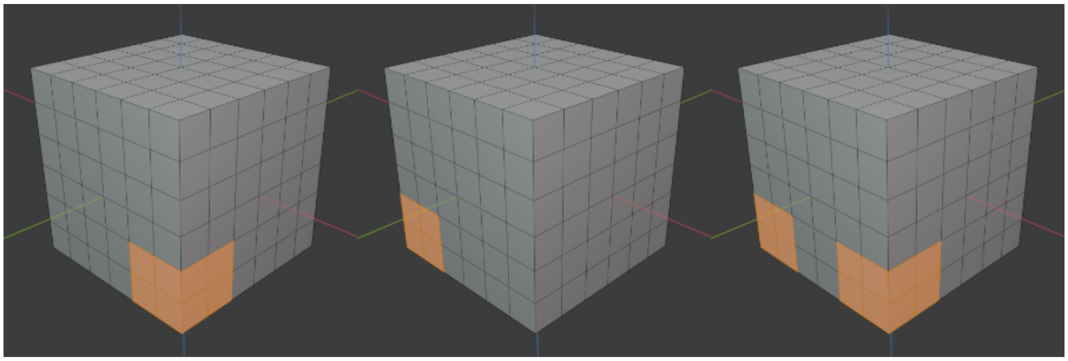
Select Mirror flips a selection to the opposite side of the mesh.

Axis

Choose on which axis the selection will occur. The axis is based on the meshes origin. Therefore, if the origin is not centered within the mesh, the selection will have varying results.

Extend

The new selection will include the mirrored selection as well as the original.

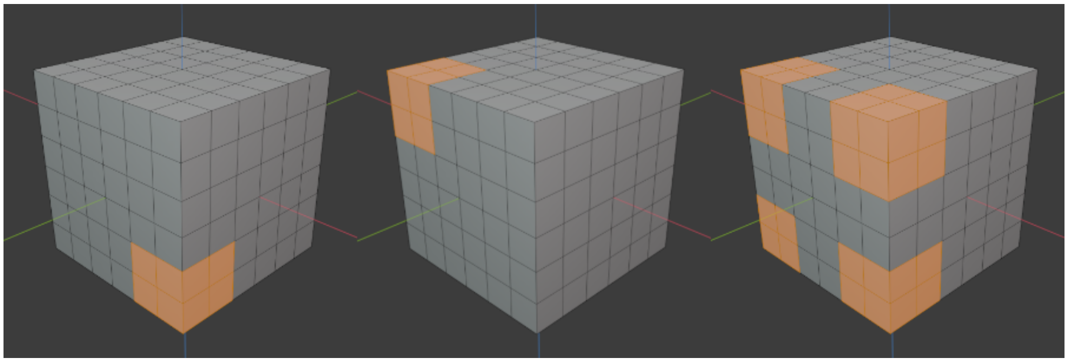


(From left to right) initial selection, after Select Mirror on the X axis, with Extend.

Tip

With *Extend* activated, hold `Shift` while choosing an axis to include more than one axis in the selection. Otherwise, with *Extend* off, the mirror will take into account two to three axes.

Example



(From left to right) initial selection, mirrored along X and Z axes, with Extend.

Select Random

Reference

Mode::	Object Mode
Menu::	*Select ‣ Select Random*

Randomly selects unselected vertices, edges, or faces based on percentage probability.

Percent
: The likelihood of an unselected mesh element being selected. Note that this is not the percentage amount of elements that will be selected.

Checker Deselect

Reference

Mode::	Edit Mode
Menu::	*Select ‣ Checker Deselect*

This tool applies an alternating selected/deselected checker pattern. This only works if you already have more than one mesh element selected.

Changes the current selection so that only every Nth elements (vertices, edges or faces, depending on the active selection mode) will remain selected, starting from the active one.

In case of islands of selected elements, this tool will affect only the island of the active element (if there is one), or the island of the first element in the order of internal storage (if there is no active element).

Deselected
: The number of deselected elements in each pattern repetition.

Selected
: The number of selected elements in each pattern repetition.

Offset
: Offset from the starting point.

Select More/Less

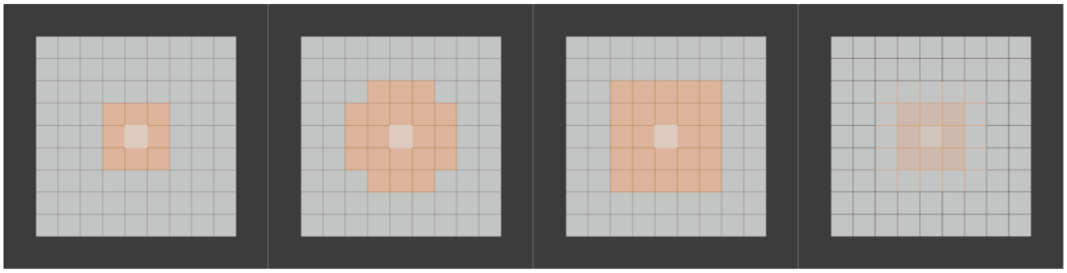
Reference

Mode::	Edit Mode
Menu::	*Select* ‣ *Select More/Less* ‣ *More*
Shortcut::	`Ctrl-NumpadPlus`
Menu::	*Select* ‣ *Select More/Less* ‣ *Less*
Shortcut::	`Ctrl-NumpadMinus`

With at least one vertex, edge, or face selected, *Select More/Less* expands or shrinks the selection. However, if there is only one selection in any selection mode, *Less* will deselect it.

Face Step

With *Face Step* on, each use of the tool will affect the size of the selection on a face by face basis. When deactivated, it will be based on either vertices or edges depending on which Selection Mode is active.



(From left to right) initial selection, without Face Step, with Face Step, and in edge selection mode.

Select Next/Previous Active

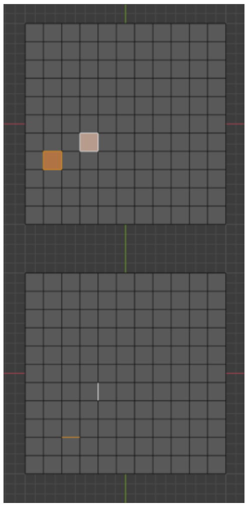
Reference

Mode::	Edit Mode

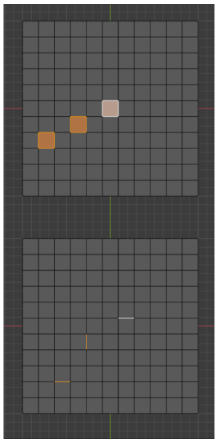
Menu::	*Select ▸ Select More/Less ▸ Next Active*
Shortcut::	`Shift-Ctrl-NumpadPlus`
Menu::	*Select ▸ Select More/Less ▸ Previous Active*
Shortcut::	`Shift-Ctrl-NumpadMinus`

Next Active

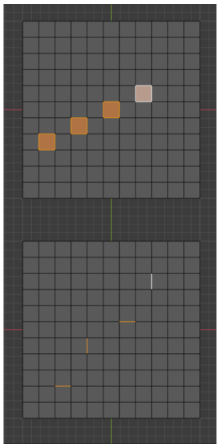
This uses selection history to select the next vertex, edge, or face based on the surrounding topology. Which means that, it will derive the next selection from the previous two selections.



Initial selection.



Using Next Active once.



Using Next Active twice.

Previous Active

Only the last selected element will be removed.

Select Similar

Reference

Mode::	Edit Mode
Menu::	*Select ‣ Similar*
Shortcut::	`Shift-G`

Select geometry that has similar certain properties to the ones selected, based on a threshold that can be set in tool properties after activating the tool. Tool options change depending on the selection mode:

Vertex Selection Mode:

Normal
Selects all vertices that have normals pointing in similar directions to those currently selected.

Amount of Adjacent Faces
Selects all vertices that have the same number of faces connected to them.

Vertex Groups
Selects all vertices in the same vertex group.

Amount of Connecting Edges
Selects all vertices that have the same number of edges connected to them.

Edge Selection Mode:

Length
Selects all edges that have a similar length as those already selected.

Direction
Selects all edges that have a similar direction (angle) as those already selected.

Amount of Faces Around an Edge

Selects all edges that belong to the same number of faces.

Face Angles

Selects all edges that are between two faces forming a similar angle, as with those already selected.

Crease

Selects all edges that have a similar Crease value as those already selected.

Bevel

Selects all edges that have the same *Bevel Weight* as those already selected.

Seam

Selects all edges that have the same *Seam* state as those already selected. *Seam* is a mark used in UV texturing.

Sharpness

Selects all edges that have the same *Sharp* state as those already selected. *Sharp* is a mark used by the Edge Split Modifier.

Face Selection Mode:

Material

Selects all faces that use the same material as those already selected.

Area

Selects all faces that have a similar area as those already selected.

Polygon Sides

Selects all faces that have the same number of edges.

Perimeter

Selects all faces that have a similar perimeter (added values of its edge lengths).

Normal

Selects all faces that have a similar normal as those selected. This is a way to select faces that have the same orientation (angle).

Co-planar

Selects all faces that are (nearly) in the same plane as those selected.

Flat/Smooth

Selects all faces with similar face shading.

Freestyle Face Marks

Selects all faces with similar Freestyle Face Marks.

Compare

For quantitative properties, this property selects the type of comparison to between the two numerical values.

Equal::	Select items with the same value as the active item’s chosen property.
Greater::	Select items with a larger value as the active item’s chosen property.
Less::	Select items with a smaller value as the active item’s chosen property.

Threshold

For quantitative properties, this property controls how close the property’s values have to be in the comparison.

Face Regions

Reference

Mode::	Edit Mode
Menu::	*Select ‣ Similar ‣ Face Regions*

Select matching features on a mesh that has multiple similar areas based on the topology.

Select All by Trait

Non-Manifold

Reference

Mode::	Edit Mode
Menu::	*Select* ‣ *Select All by Trait* ‣ *Non-Manifold*

Selects the Non-manifold geometry of a mesh. This entry is available when editing a mesh, in Vertex and Edge selection modes only.

Extend	Lets you extend the current selection.
Wire	Selects all the edges that do not belong to any face.
Boundaries	Selects edges in boundaries and holes.
Multiple Faces	Selects edges that belong to three or more faces.
Non Contiguous	Selects edges that belong to exactly two faces with opposite normals.
Vertices	Selects vertices that belong to *wire* and *multiple face* edges, isolated vertices, and vertices that belong to non-adjoining faces.

Loose Geometry

Reference

Mode:: Edit Mode
Menu:: *Select ▸ Select All by Trait ▸ Loose Geometry*

This selection depends on the currently selected Selection Modes; In vertex and edge selection mode it selects all vertices or edges that do not form part of a face. In face selection mode it selects all faces that do not share edges with other faces.

Interior Faces

Reference

Mode:: Edit Mode
Menu:: *Select ▸ Select All by Trait ▸ Interior Faces*

Selects faces where all edges have more than two faces.

Faces by Sides

Reference

Mode:: Edit Mode
Menu:: *Select ▸ Select All by Trait ▸ Faces by Sides*

Selects all faces that have a specified number of edges.

Ungrouped Vertices

Reference

Mode:: Edit Mode
Menu:: *Select ▸ Select All by Trait ▸ Ungrouped Vertices*

Selects all vertices which are not part of a vertex group.

Select Linked

Linked

Reference

Mode::	Edit Mode
Menu::	*Select* ‣ *Select Linked* ‣ *Linked*
Shortcut::	`Ctrl-L`

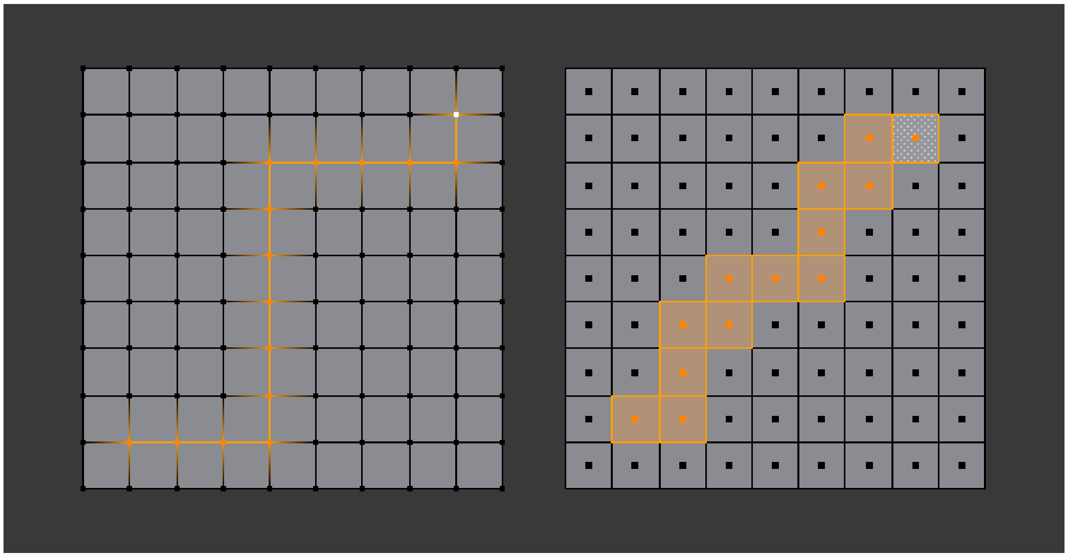
Select geometry connected to already selected elements. This is often useful when a mesh has disconnected, overlapping parts, where isolating it any other way would be tedious. To give more control, you can also enable delimiters in the Adjust Last Operation panel, so the selection is constrained by seams, sharp edges, materials or UV islands.

With *Pick Linked* you can also select connected geometry directly under the cursor, using the `L` shortcut to select or `Shift-L` to deselect linked. This works differently in that it uses the geometry under the cursor instead of the existing selection.

Shortest Path

Reference

Mode::	Edit Mode
Menu::	*Select* ‣ *Select Linked* ‣ *Shortest Path*
Shortcut::	`Ctrl-LMB`



Select a face or vertex path with `Ctrl-LMB`.

Selects all geometry along the shortest path from the active vertex, edge, or face to the one which was selected.

Edge Tag (in Edge select mode only)

This select button indicates what should be done when selecting a vertex path with `Ctrl-LMB`:

Select

Just selects all the edges in the path.

Tag Seam

Marks all edges in the path as seams for UV unwrapping.

Tag Sharp

Marks all edges in the path as sharp for the Edge Split Modifier.

Tag Crease

Marks all edges in the path as creases for the Subdivision Surface Modifier, with weight 1.0.

Tag Bevel

Gives bevel weight 1.0 (for the Bevel Modifier) to all edges in the path.

Tag Freestyle Edge Mark

Marks all edges in the path as Freestyle edges.

Face Stepping

Supports diagonal paths for vertices and faces, and selects edge rings with edges.

Topology Distance

Only takes into account the number of edges of the path and not the length of the edges to calculate the distances.

Fill Region `Shift-Ctrl-LMB`

Selects all elements in the shortest paths from the active selection to the clicked area.

Checker Deselect Options

Allows to quickly select alternate elements in a path.

Deselected

The number of deselected elements in the repetitive sequence.

Selected

The number of selected elements in the repetitive sequence.

Offset

Offset from the starting point.

Linked Flat Faces

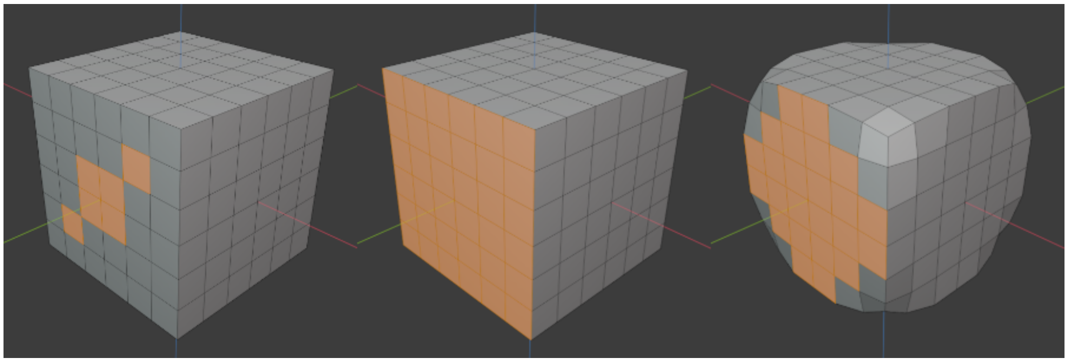
Reference

Mode::	Edit Mode
Menu::	*Select ‣ Select Linked ‣ Linked Flat Faces*

Selects all connected faces with a similar angle.

Sharpness

Select connected faces with a reference angle less than the value specified.



Looking at the image above, when at least one face is selected (as seen on the left), *Linked Flat Faces* will select all connecting faces that lie on the same or similar plane (as shown in the middle image). If the corners are smoothed, those faces are no longer lined up with the selected faces. At this point, increasing the *Sharpness* value in the tool options could include the smoothed faces.

Select Loops

Select Edge Loops

Reference

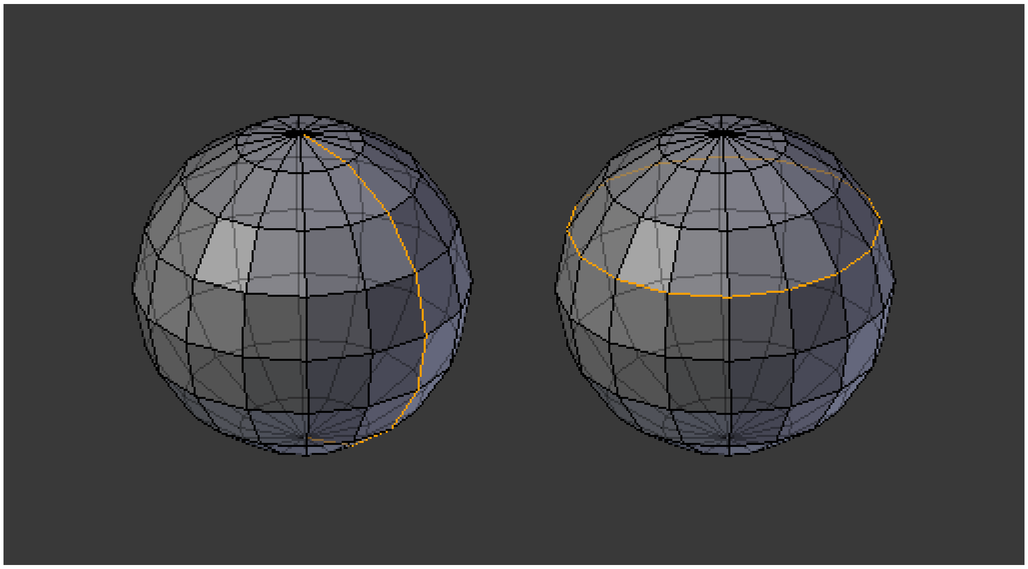
Mode:: Edit Mode (Vertex or Edge select mode)
Menu:: *Select ‣ Select Loops ‣ Edge Loops*
Shortcut:: `Alt-LMB`, or `Shift-Alt-LMB` for modifying existing selection.

Holding `Alt` while selecting an edge selects a loop of edges that are connected in a line end-to-end, passing through the edge under the mouse pointer. Holding `Shift-Alt` while clicking adds to the current selection.

Note

Vertex mode

In *Vertex* select mode, you can also select edge loops, by using the same shortcuts, and clicking on the *edges* (not on the vertices).



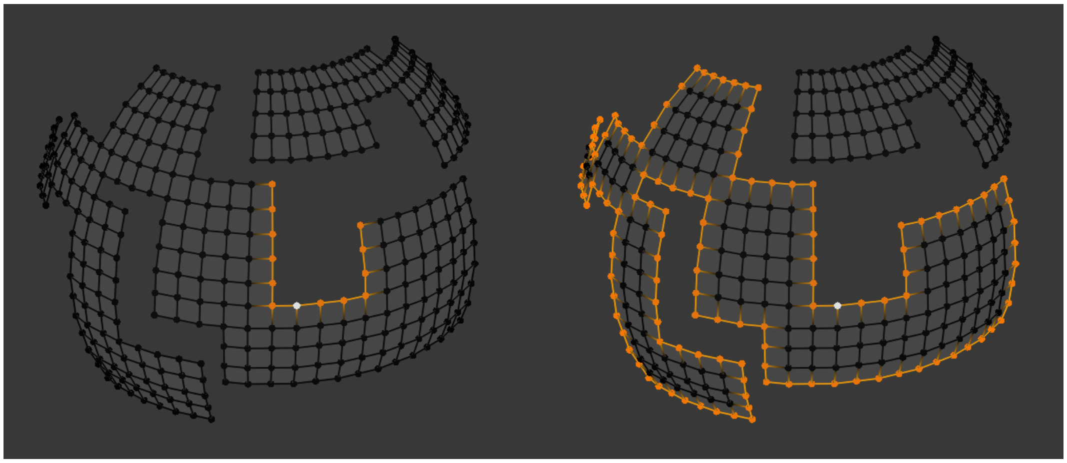
Longitudinal and latitudinal edge loops.

The left sphere shows an edge that was selected longitudinally. Notice how the loop is open. This is because the algorithm hit the vertices at the poles and is terminated because the vertices at the pole connect to more than four edges. However, the right sphere shows an edge that was selected latitudinally and has formed a closed loop. This is because the algorithm hit the first edge that it started with.

Select Edge Loops (All Boundaries)

All boundary edges can be selected by performing a second loop select action on a boundary edge.

This can be useful for selecting boundaries for meshes that include triangles and n-gons, where loop select would not otherwise select the full boundary.



The second loop select action is shown on the right.

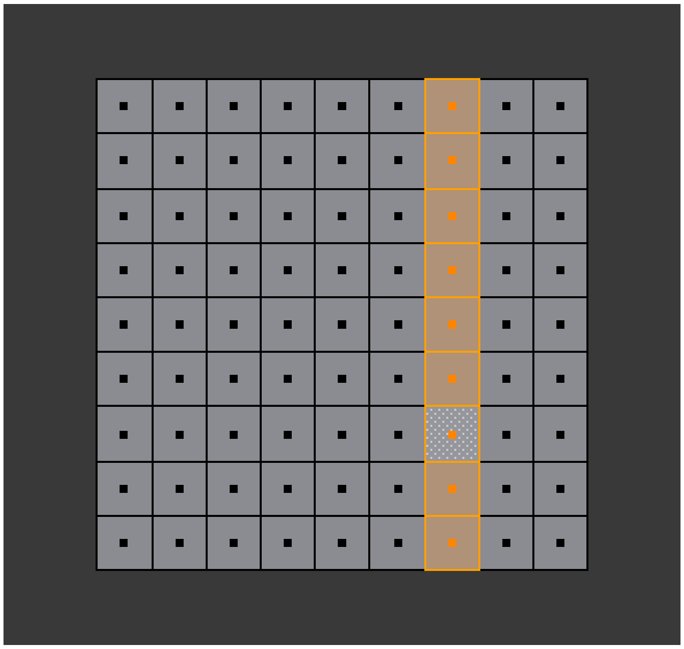
Select Face Loops

Reference

Mode::	Edit Mode (Face or Vertex select modes)
Shortcut::	`Alt-LMB` or `Shift-Alt-LMB` for modifying existing selection.

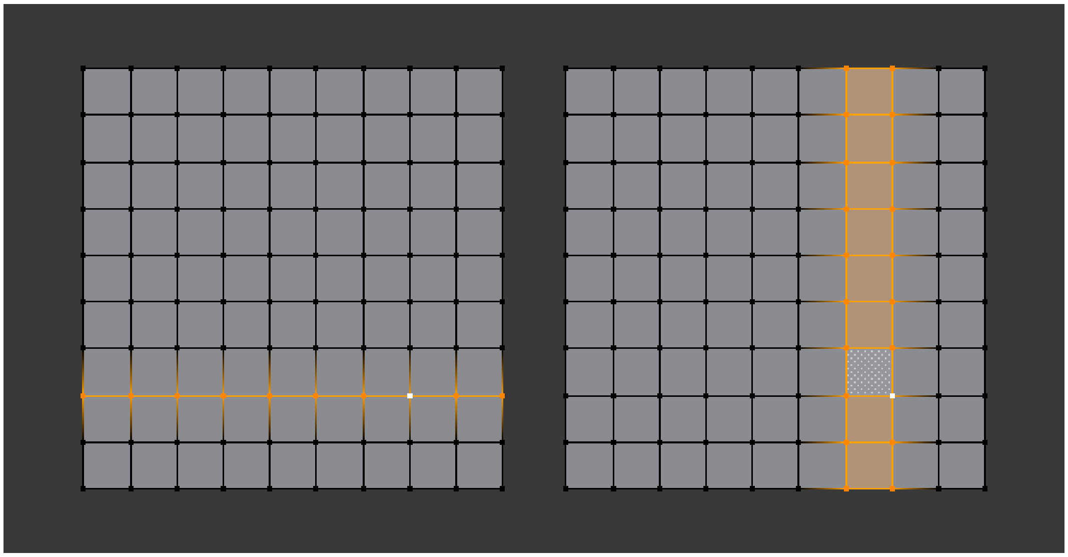
In face select mode, holding `Alt` while selecting an *edge* selects a loop of faces that are connected in a line end-to-end, along their opposite edges.

In vertex select mode, the same can be accomplished by using `Ctrl-Alt` to select an edge, which selects the face loop implicitly.



Face loop selection.

This face loop was selected by clicking with `Alt-LMB` on an edge, in *face* select mode. The loop extends perpendicular from the edge that was selected.



`Alt` versus `Ctrl-Alt` in vertex select mode.

A face loop can also be selected in *Vertex* select mode. Technically `Ctrl-Alt-LMB` will select an *Edge Ring*, however, in *Vertex* select mode, selecting an *Edge Ring* implicitly selects a *Face Loop* since selecting opposite edges of a face implicitly selects the entire face.

Select Edge Rings

Reference

Mode::	Edit Mode
Menu::	*Select* ▸ *Select Loops* ▸ *Edge Rings*
Shortcut::	`Ctrl-Alt-LMB`

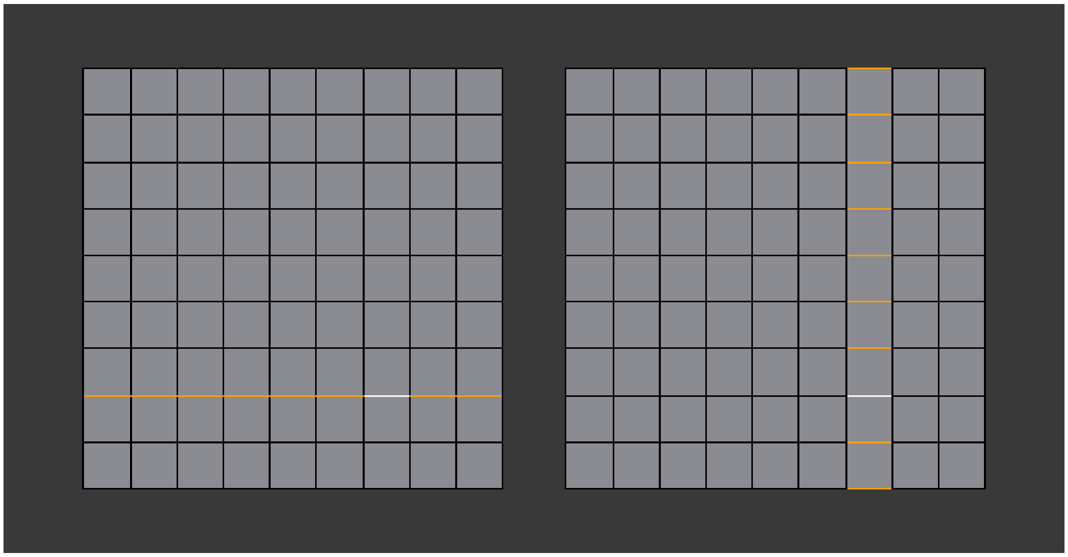
In *Edge* select mode, holding `Ctrl-Alt` while selecting an edge (or two vertices) selects a sequence of edges that are not connected, but on opposite sides to each other continuing along a face loop.

As with edge loops, you can also select edge rings based on current selection, using either *Select* ▸ *Select Loops* ▸ *Edge Rings*.

Note

Vertex mode

In *Vertex* select mode, you can use the same shortcuts when *clicking on the edges* (not on the vertices), but this will directly select the corresponding face loop…



A selected edge loop, and a selected edge ring.

In Fig. A selected edge loop, and a selected edge ring. the same edge was clicked on, but two different "groups of edges" were selected, based on the different tools. One is based on edges during computation and the other is based on faces.

Note

Convert Selection to Whole Faces

If the edge ring selection happened in Edge Select Mode, switching to Face Select Mode will erase the selection.

This is because none of those faces had all its (four) edges selected, just two of them.

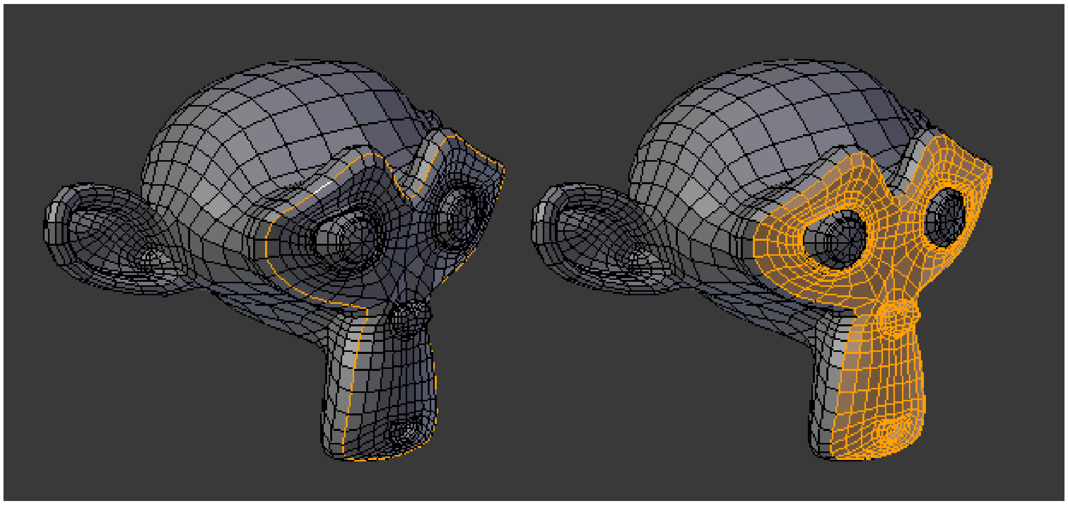
Instead of selecting the missing edges manually or by using `Shift-Alt-LMB` twice, it is easier to first switch to Vertex Select Mode, which will kind of "flood" the selection. A subsequent switch to Face Select Mode will then properly select the faces.

Select Loop Inner-Region

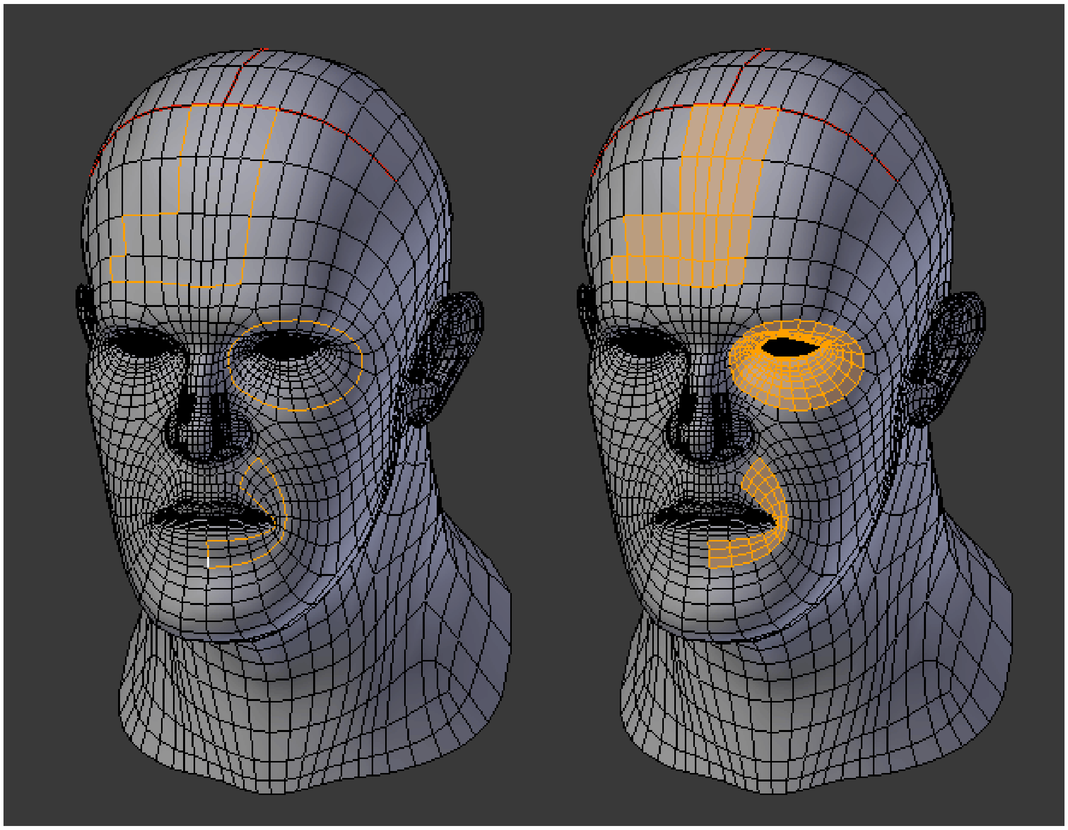
Reference

Mode::	Edit Mode (Edge select mode)
Menu::	*Select ‣ Select Loops ‣ Select Loop Inner-Region*

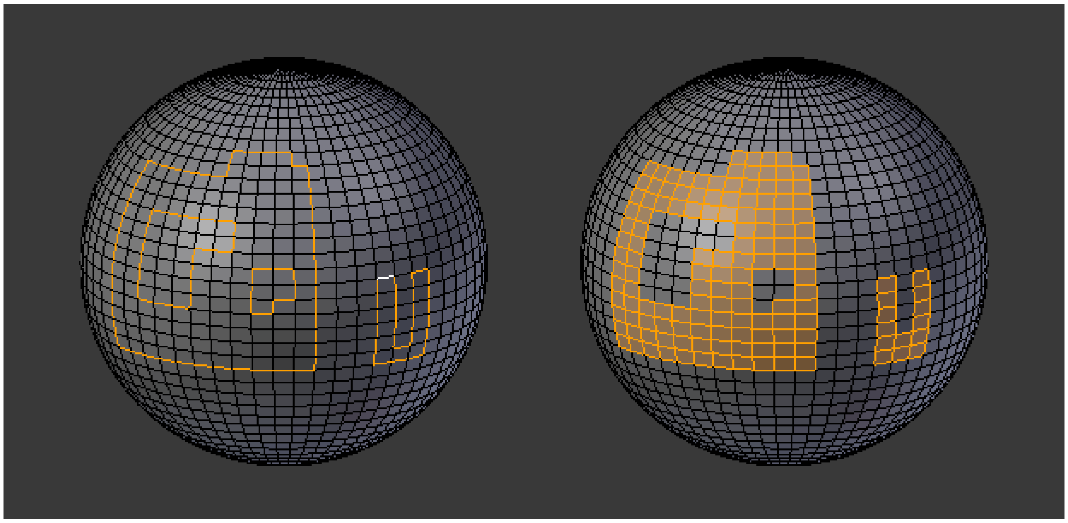
Select Loop Inner-Region selects all faces that are inside a closed loop of edges. While it is possible to use this operator in *Vertex* and *Face* selection modes, results may be unexpected. Note that if the selected loop of edges is not closed, then all connected edges on the mesh will be considered inside the loop.



Loop to Region.



This tool handles multiple loops fine, as you can see.



This tool handles “holes” just fine as well.

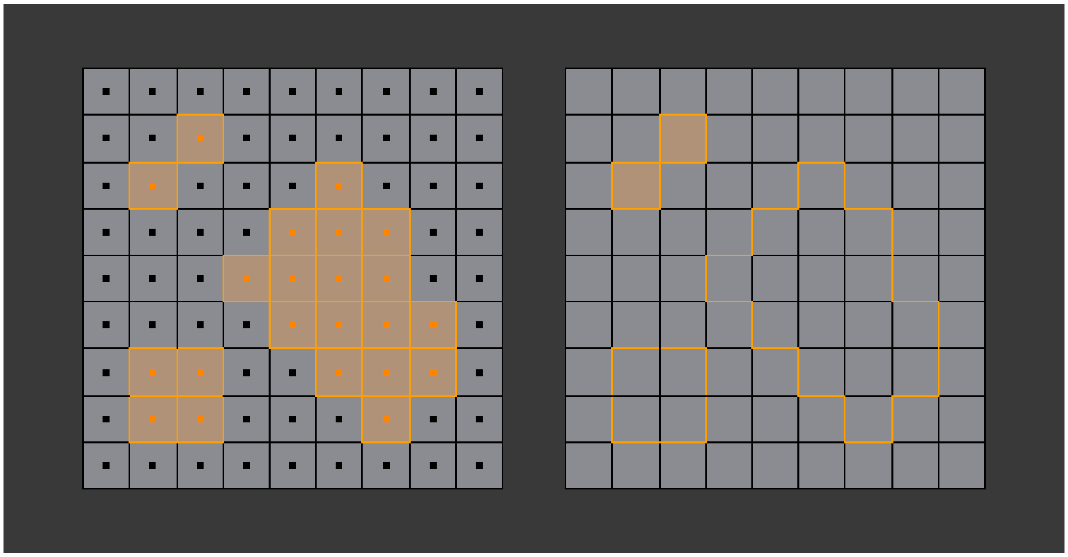
Select Boundary Loop

Reference

Mode::	Edit Mode (Edge select mode)
Menu::	*Select ‣ Select Loops ‣ Select Boundary Loop*

Select Boundary Loop does the opposite of *Select Loop Inner-Region*, based on all regions currently selected, it selects only the edges at the border (contour) of these islands. It can operate in any select mode, but when in *Face* mode it will switch to *Edge* select mode after running.

All this is much more simple to illustrate with examples:



Select Boundary Loop does the opposite and forces into Edge Select Mode.

Select Sharp Edges

Reference

Mode::	Edit Mode
Menu::	*Select ‣ Select Sharp Edges*

Selects edges whose faces intersect at an acute angle. This can be useful to find hard edges in a mesh.

Sharpness
: Determines how sharp of an angle at an edge needs to be in order for it to be selected.

Side of Active

Reference

Mode:: Edit Mode

Menu:: *Select ‣ Side of Active*

With an active vertex, this tool will select all vertices in a specified direction. It is similarly to the *Loop Inner-Region* tool in that it will fill select faces within its perimeters, however, it is determined by direction and not by a closed loop.

Axis Mode

Determines the behavior of the selection. More information on this can be found in Transform Orientations.

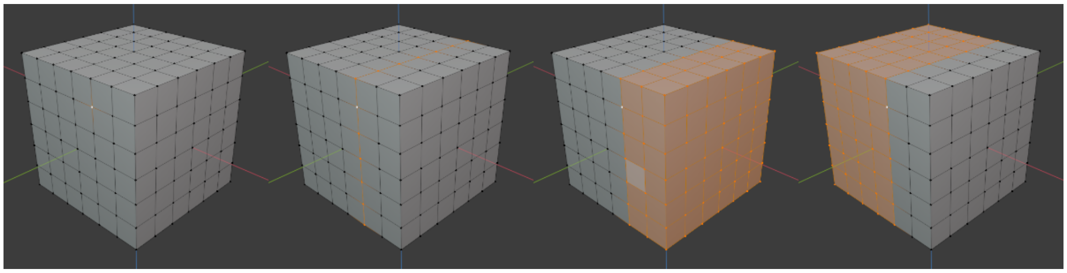
Axis Sign

Positive/Negative Axis

Depending on which *Axis* is chosen, the selection will encompass the positive or negative axis starting from the active vertex outward.

Aligned Axis

Where *Positive and Negative Axis* select all vertices in a given direction, *Aligned Axis* will only select the vertices that are in-line with the active vertex.



While following along the X axis: (from left to right) active vertex, Aligned, Positive, and Negative.

Axis

Chooses the direction of the selection.

Threshold

The amount of influence the selection has outside the original perimeters. The higher the *Threshold* the more vertices will be selected.

By Attribute

Reference

Mode:: Edit Mode
Menu:: *Select* ▸ *By Attribute*

Selects vertices, edges, or faces based on the Active Attribute.

Usage

Note

- The active attribute must have a boolean type.
- The active attribute must be on the vertex, edge, or face domain.

1. Select the desired attribute from the Attribute List.
2. Execute the *By Attribute* operator.

Editing

- Introduction
  - Accessing Mesh Operators
- Mesh Operators
  - Transformation
  - Mirror
  - Duplicate
  - Extrude
  - Merge
  - Split
  - Separate
  - Bisect
  - Knife Project
  - Knife Topology Tool
  - Convex Hull
  - Symmetrize
  - Snap to Symmetry
  - Normals
  - Shading
  - Set Attribute
  - Sort Elements
  - Clean Up
  - Deleting & Dissolving
- Vertex Operators
  - Extrude Vertices
  - Extrude to Cursor or Add
  - Bevel Vertices
  - New Edge/Face from Vertices
  - Connect Vertex Path
  - Connect Vertex Pairs
  - Rip Vertices
  - Rip Vertices and Fill
  - Rip Vertices and Extend
  - Slide Vertices

  - Smooth Vertices
  - Laplacian Smooth
  - Blend from Shape
  - Propagate to Shapes
  - Vertex Groups
  - Hooks
  - Make Vertex Parent
- Edge Operators
  - Extrude Edges
  - Bevel Edges
  - Bridge Edge Loops
  - Screw
  - Subdivide
  - Subdivide Edge-Ring
  - Un-Subdivide
  - Rotate Edge
  - Edge Slide
  - Offset Edge Slide
  - Loop Cut and Slide
  - Edge Data
- Face Operators
  - Extrude Faces
  - Extrude Faces Along Normals
  - Extrude Individual Faces
  - Inset Faces
  - Poke Faces
  - Triangulate Faces
  - Triangles to Quads
  - Solidify Faces
  - Wireframe
  - Fill
  - Grid Fill
  - Beautify Faces
  - Intersect (Knife)
  - Intersect (Boolean)
  - Weld Edges into Faces
  - Shade Smooth & Flat

  - Face Data
- UV Operators
  - Unwrap
  - Smart UV Project
  - Lightmap Pack
  - Follow Active Quads
  - Cube Projection
  - Cylinder Projection
  - Sphere Projection
  - Project from View
  - Project from View (Bounds)
  - Reset

Introduction

Blender provides a variety of operators for editing meshes. These operators are used to add, duplicate, move and delete elements.

These are available through the Menus in the 3D Viewport header, and context menus in the 3D Viewport, as well as individual shortcut keys.

Note

All the "transform precision/snap" keys `Ctrl` and/or `Shift` also work for all these advanced operations, but most of them do not have axis locking possibilities, and some of them do not take into account the pivot point and/or transform orientation either.

These transform operators are available in the *Transform* section of the *Mesh* menu in the header. Note that, some of these can also be used on other editable objects, like curves, surfaces, and lattices.

Accessing Mesh Operators

The mesh editing operations are found in various places, and available through shortcuts as well.

Menus

These menus are located in the header. Some of the menus can be accessed with shortcuts:

- `Ctrl-F` brings up the Face operators menu
- `Ctrl-E` brings up the Edge operators menu
- `Ctrl-V` brings up the Vertex operators menu

Mesh Operators

- Transformation
  - Move, Rotate, Scale
  - To Sphere
  - Shear
  - Bend
  - Push/Pull
  - Warp
  - Randomize
  - Shrink/Fatten
  - Skin Resize
- Mirror
  - Axis of Symmetry
  - Pivot Point
  - Transformation Orientations
- Duplicate
- Extrude
  - Extrude Faces
  - Extrude Faces Along Normals
  - Extrude Individual Faces
  - Extrude Manifold
  - Extrude Edges
  - Extrude Vertices
  - Extrude Repeat
  - Spin
- Merge
  - By Distance
- Split
  - Selection
  - Faces by Edges
  - Faces & Edges by Vertices
- Separate
- Bisect
  - Controls

  - Examples
- Knife Project
  - Options
  - Examples
  - Known Limitations
- Knife Topology Tool
  - Usage
  - Tool Settings
  - Controls
  - Known Limitations
- Convex Hull
- Symmetrize
- Snap to Symmetry
- Normals
  - Flip
  - Recalculate
  - Set from Faces
  - Rotate
  - Point to Target
  - Merge
  - Split
  - Average
  - Copy Vectors
  - Paste Vectors
  - Smooth Vectors
  - Reset Vectors
  - Select by Face Strength
  - Set Face Strength
- Shading
- Set Attribute
- Sort Elements
- Clean Up
  - Decimate Geometry
  - Fill Holes
  - Make Planar Faces
  - Split Non-Planar Faces
  - Split Concave Faces

  - Delete Loose
  - Degenerate Dissolve
  - Merge by Distance
- Deleting & Dissolving
  - Delete
  - Dissolve
  - Limited Dissolve
  - Collapse Edges & Faces
  - Edge Loops

Transformation

- Move, Rotate, Scale
- To Sphere
- Shear
- Bend
- Push/Pull
- Warp
- Randomize
- Shrink/Fatten
- Skin Resize

Move, Rotate, Scale

Reference

Mode::	Edit Mode
Tool::	*Toolbar* ‣ *Move, Rotate, Scale*
Menu::	*Mesh* ‣ *Transform* ‣ *Move, Rotate, Scale*
Shortcut::	`G`, `R`, `S`

Once you have a selection of one or more elements, you can move `G`, rotate `R` or scale `S` them, like many other things in Blender, as described in the Manipulation in 3D Space section. To move, rotate and scale selected components, either use the *Move*, *Rotate*, and *Scale* buttons, the transform gizmos, or the shortcuts: `G`, `R`, and `S` respectively.

After moving a selection, the options in the Adjust Last Operation panel allow you to fine-tune your changes, limit the effect to certain axes, turn Proportional Editing on and off, etc. Of course, when you move an element of a given type (e.g. an edge), you also modify the implicitly related elements of other kinds (e.g. vertices and faces).

Pressing `G` twice enters either *Edge Slide* or *Vertex Slide* tool depending on the selection. You also have in *Edit Mode* an extra option when using these basic manipulations: the Proportional Editing.

Transform Panel

Reference

Mode::	Edit Mode
Panel::	*Sidebar region* ‣ *Transform*

When nothing is selected, the panel is empty. When more than one vertex is selected, the median values is edited and “Median” is added in front of the labels.

Vertex

The first controls (X, Y, Z) show the coordinates of the selected vertex or the median point.

Space

The Space radio buttons let you choose if those coordinates are relative to the object origin (local) or the global origin (global).

Global, Local

Vertex Data

Bevel Weight

This vertex property, a value between (0.0 to 1.0), is used by the Bevel Modifier to control the bevel intensity of the vertices, when the *Only Vertices* option is active.

Crease

This vertex property, a value between (0.0 to 1.0), is used by the Subdivision Surface Modifier to control the sharpness of the vertices in the subdivided mesh.

Edge Data

When an edge is selected, the following options are available. More buttons appear:

Bevel Weight

This edge property, a value between (0.0 to 1.0), is used by the Bevel Modifier to control the bevel intensity of the edges.

This property can also be set using the Edge Bevel Weight operator.

Crease

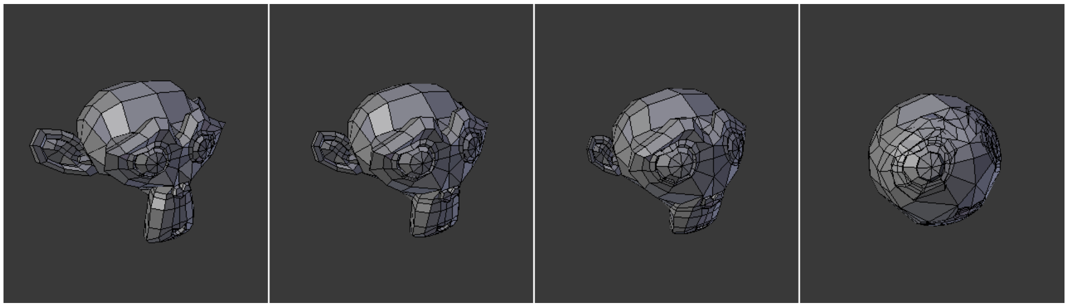
This edge property, a value between (0.0 to 1.0), is used by the Subdivision Surface Modifier to control the sharpness of the edges in the subdivided mesh.

To Sphere

Reference

Mode::	Object and Edit Modes
Menu::	*Mesh* ▸ *Transform* ▸ *To Sphere*
Shortcut::	`Shift-Alt-S`

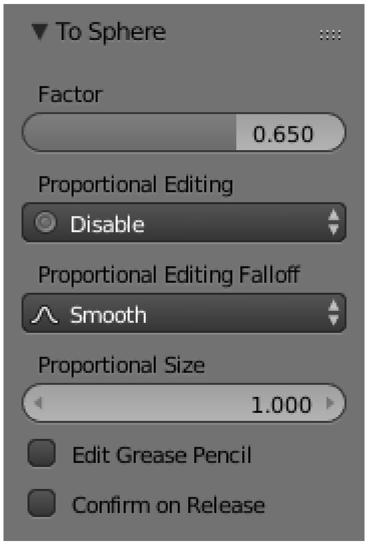
The *To Sphere* transformation will give the selection spherical qualities. The Fig. Monkey with increasing sphericity. below shows the results of applying the *To Sphere* transformation to the monkey mesh.



Monkey with increasing sphericity.

The sequence above shows a monkey mesh with a 0, 0.25 (25%), 0.5 (50%) and 1 (100%) To Sphere transform applied.

Usage



▼ To Sphere

Factor
0.650

Proportional Editing
Disable

Proportional Editing Falloff
Smooth

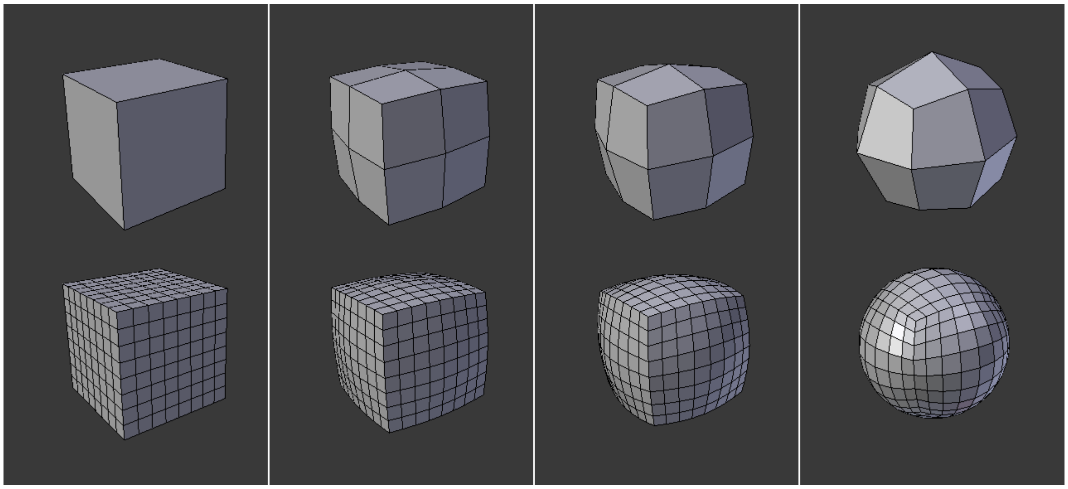
Proportional Size
1.000

☐ Edit Grease Pencil

☐ Confirm on Release

To Sphere Factor.

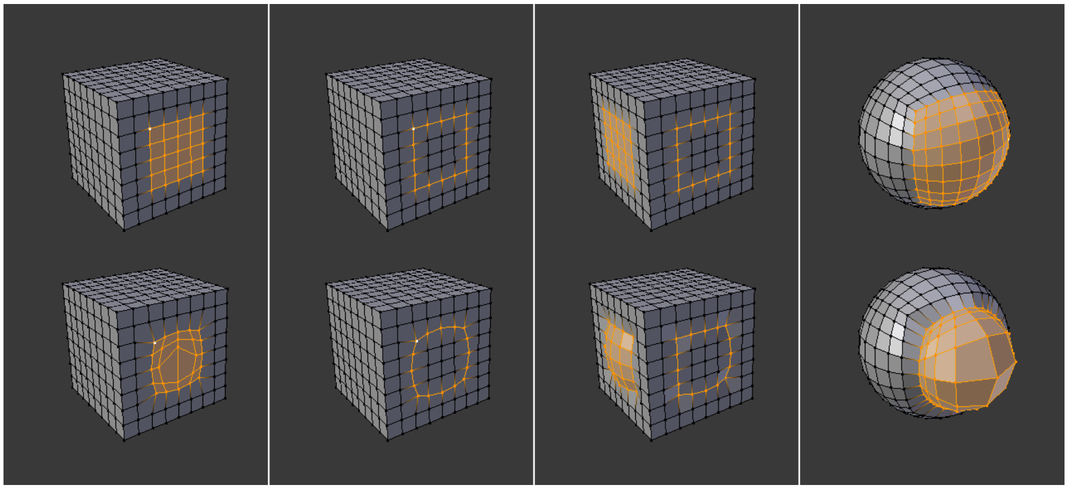
As can be seen in the below image, the result will be smoother and more spherical when there are more mesh elements available to work with.



To Sphere applied to cubes with different subdivision levels.

In this image sequence, To Sphere was applied to the entire cube at levels of 0, 0.25 (25%), 0.5 (50%) and 1 (100%) respectively.

The *To Sphere* transform will generate different results depending on the number and arrangement of elements that were selected (as shown by the below image).



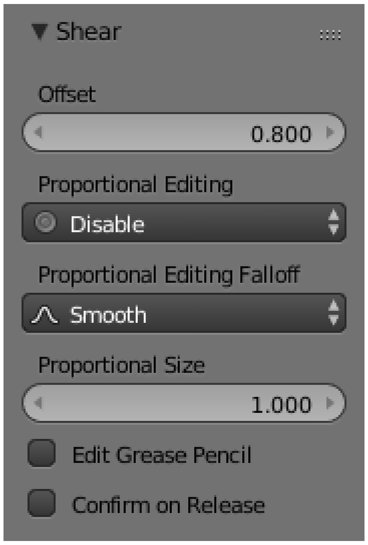
To Sphere applied to different selections.

Shear

Reference

Mode::	Object and Edit Mode
Tool::	*Toolbar* ‣ *Shear*
Menu::	*Object/Mesh/Curve/Surface* ‣ *Transform* ‣ *Shear*
Shortcut::	`Shift-Ctrl-Alt-S`

Shearing is a form of movement where parallel surfaces move past one another. During this transform, movement of the selected elements will occur along the horizontal axis of the current view. The axis location will be defined by the Pivot Point. Everything that is "above" this axis will move (shear) in the same direction as your mouse pointer (but always parallel to the horizontal axis). Everything that is "below" the horizontal axis will move in the opposite direction.



▼ Shear

Offset: 0.800

Proportional Editing: Disable

Proportional Editing Falloff: Smooth

Proportional Size: 1.000

☐ Edit Grease Pencil

☐ Confirm on Release

Shear Offset Factor.

Tool Settings

Offset
    How far items are shifted from their original location.

Axis
    Defines one axis of the imaginary shearing plane.

Axis Orthographic
    Defines the other axis of the imaginary shearing plane.

Orientation
    See Transform Orientations.

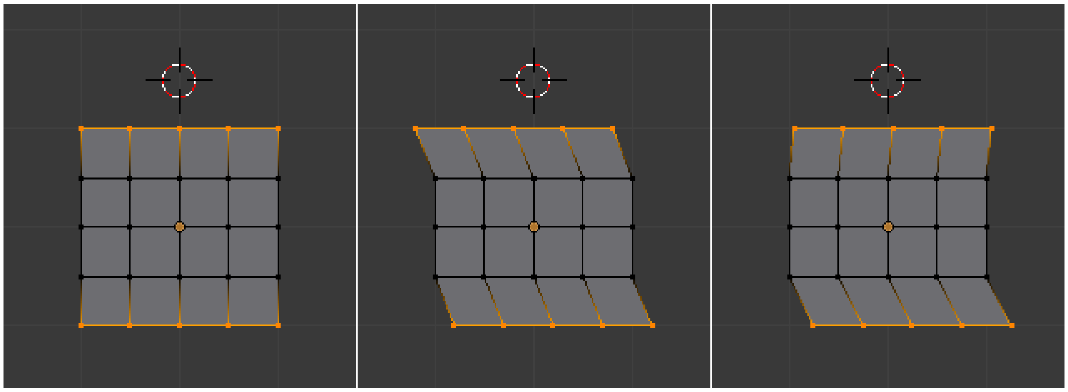
Proportional Editing
    See Proportional Editing.

Warning

The *Axis* and *Axis Orthographic* cannot be the same axis, else the imaginary plane is dimensionless and the objects will disappear into a point.

Usage

See below for the result of using *Shear* on a number of different elements.



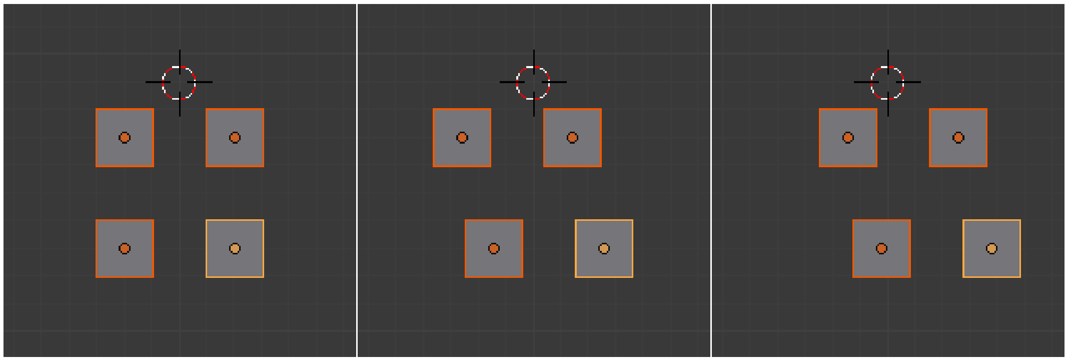
The effects of a Shear transform with different Pivot Points.

The three frames of the image above show the effects of shearing on the selected vertices when the pivot point is altered. In middle frame, the Pivot Point is set to *Median Point* and the mouse was moved to the left during the transform. In right frame, the *Pivot Point* is set to the 3D cursor which is located above the mesh. When the mouse is moved to the left during a *Shear* transform, the selected vertices are moved to the right as they are below the horizontal axis.

Tip

Shear Transform Magnitude

The magnitude of the *Shear* transform applied to the selected elements is directly proportional to the distance from the horizontal axis. i.e. the further it is away from the axis, the greater the movement.



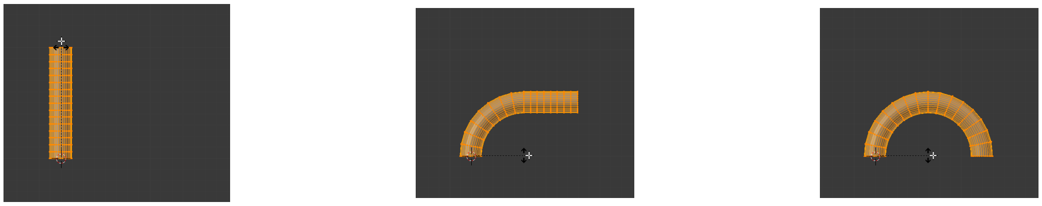
The effects of a Shear transform on objects with different Pivot Points.

Bend

Reference

Mode::	Object and Edit Modes
Menu::	*Object/Mesh/Curve/Surface* ▸ *Transform* ▸ *Bend*
Shortcut::	`Shift-W`

Bend Transform with Clamp on and off.



Before.

Clamp on.

Clamp off.

This tool rotates a line of selected elements forming an arc between the mouse cursor and the 3D cursor.

Usage

The *Bend* tool can be used in any case where you might want to bend a shape in two with a gradual transition between both sides.

This may take a little getting used to, the basics are listed below controls are noted here:

- The initial position of the cursors define the axis to bend on.
- The distance of the mouse cursor to the 3D cursor controls how sharp the bend will be.
- The relative angle of the mouse cursor to the initial axis defines the bend angle.

If this seems overly complicated, it's probably best to try the tool where it becomes quickly apparent how the tool reacts to your input.

Bend Angle

The amount of rotation.

Radius

The sharpness of the bend.

Clamp

Normally the arc turns through a clamped rotation angle with the selected elements extended along a tangent line beyond that (see above left). When the clamp is deactivated, the arc continues around aligning the selected elements into a circle (right).

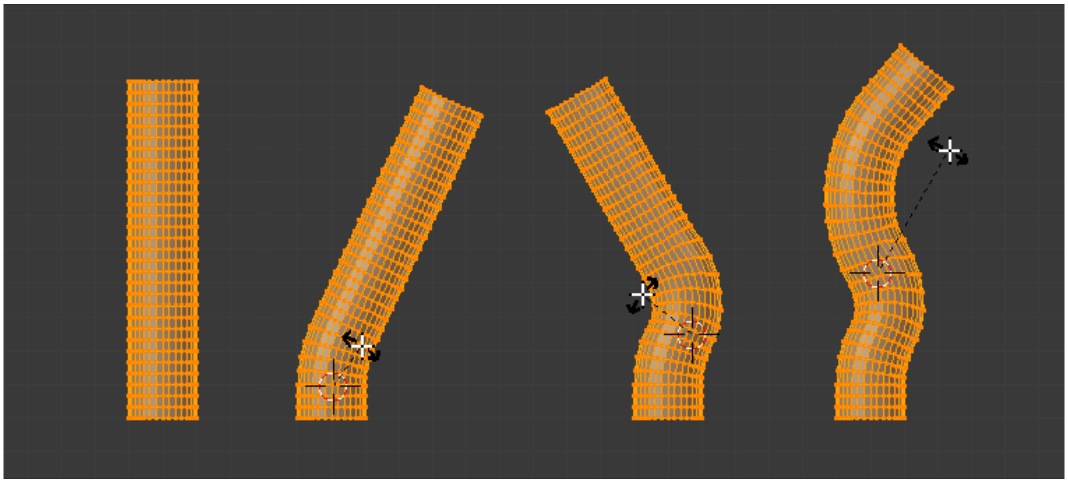
When off `Alt` all selected elements follow a circle, even when outside the segment between the 3D cursor and the mouse.

Note

Unlike most other transform modes, *Bend* is not effected by *Pivot Point* or *Transform Orientation*, always using the View Plane instead.

Hint

You can turn the bend angle through multiple rotations potentially forming a spiral shape.



Bend Transform example.

Known Limitations

Adjust Last Operation Unsupported

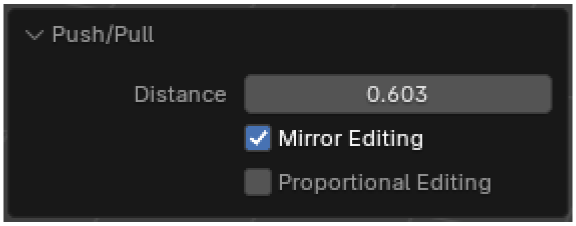
Since the bend tool relies on cursor input, it does not support adjusting the last bend operation.

Push/Pull

Reference

Mode:: Object and Edit Modes
Tool:: *Toolbar ‣ Shrink/Fatten ‣ Push/Pull*
Menu:: *Object/Mesh ‣ Transform ‣ Push/Pull*

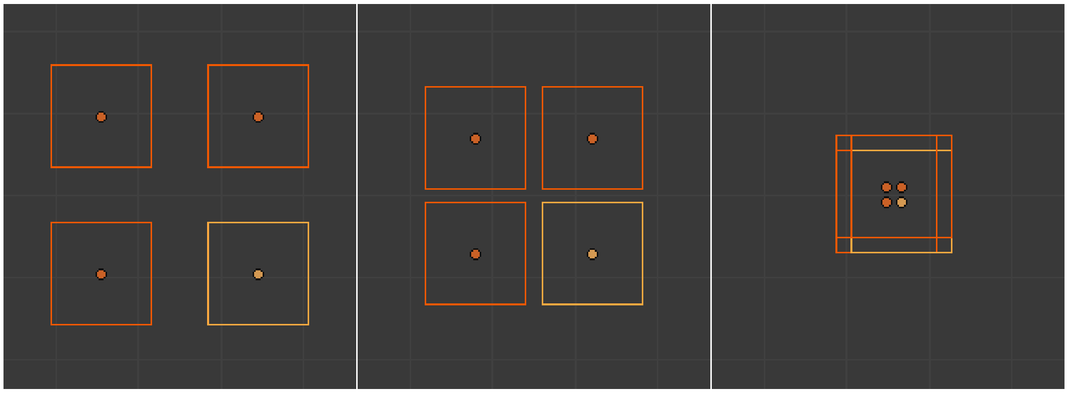
Moves the selected elements closer to (Push) or further away from (Pull) the pivot point, all by the same distance. You can control this distance by moving the mouse up or down, typing a number, or using the slider in the Adjust Last Operation panel.



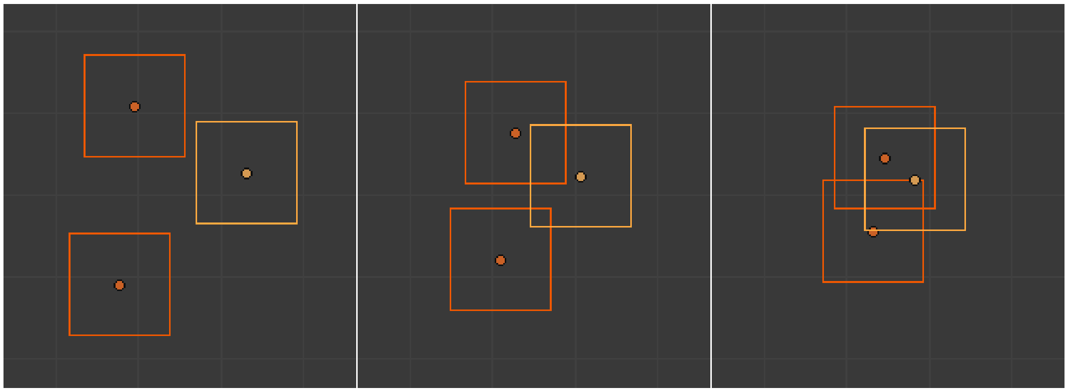
Distance 0.603
☑ Mirror Editing
☐ Proportional Editing

Push/Pull distance.

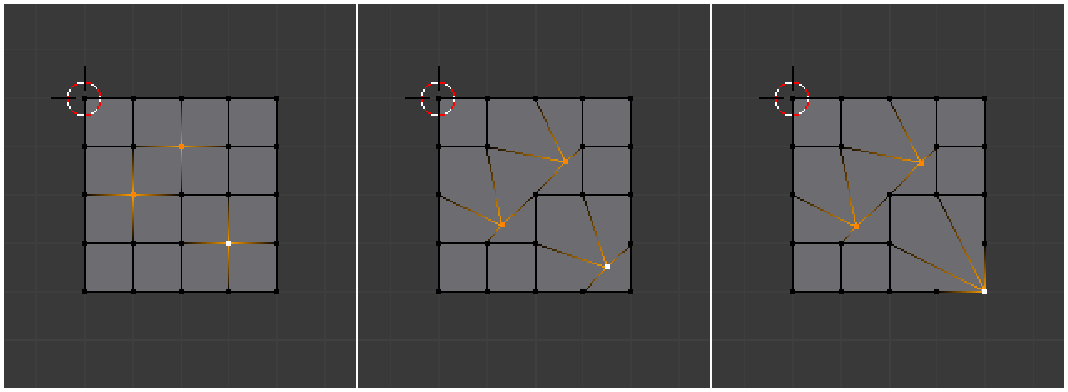
Examples



Equidistant objects being pushed together.



Random objects being pushed together.



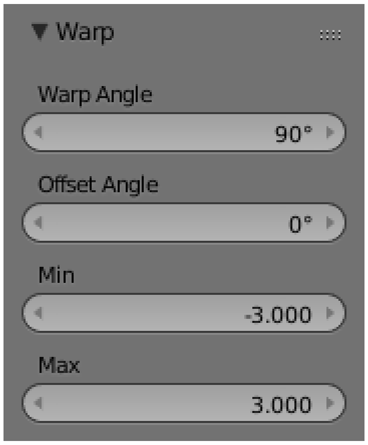
Push (middle) vertices around the 3D cursor compared to Scale (right).

Warp

Reference

Mode:: Edit Modes
Menu:: *Object/Mesh/Curve/Surface* ▸ *Transform* ▸ *Warp*

The *Warp* transformation takes selected elements and warps them around the 3D cursor by a certain angle. Note that this transformation is always dependent on the location of the 3D cursor. The Pivot Point is not taken into account. The results of the *Warp* transformation are also view dependent.

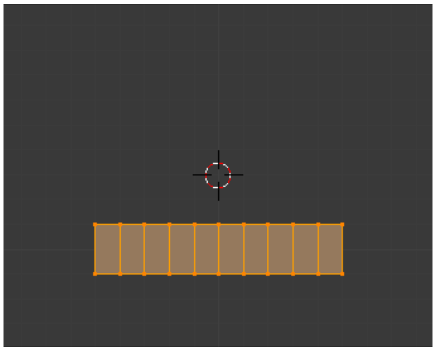


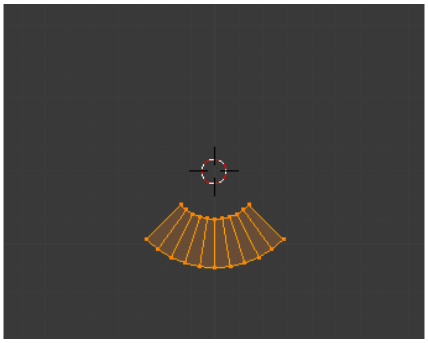
Warp Angle: 90°
Offset Angle: 0°
Min: -3.000
Max: 3.000

Warp options.

Usage

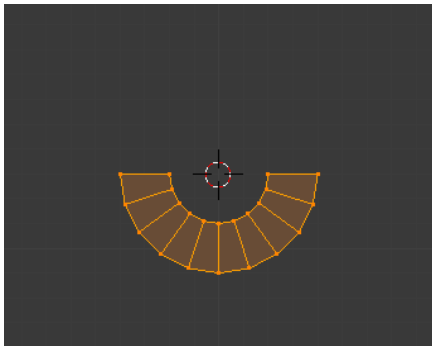
In this example, a plane is warped around the 3D cursor by the indicated number of degrees.

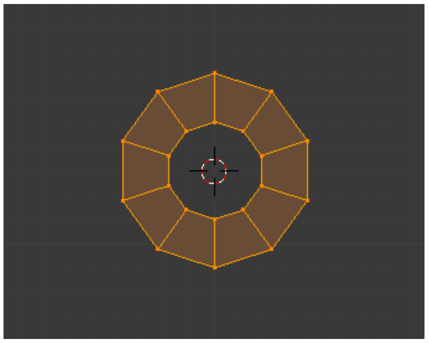




Before.

Warp Angle 90.





Warp Angle 180.

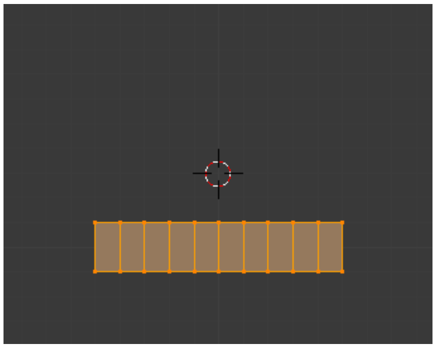
Warp Angle 360.

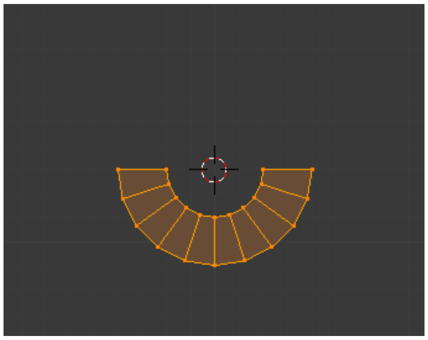
Cursor Position & View

The location of the 3D cursor can be used to alter the results of the *Warp* transformation. As can be seen from the example in this section, the *Warp* radius is dependent on the distance of the cursor from the selected elements. The greater the distance, the greater the radius.

The result of the *Warp* transform is also influenced by your current view. The example in this section shows the results of a 180 degree *Warp* transform applied to the same Plane mesh when in different views.

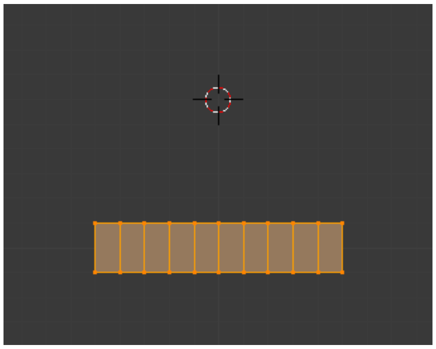
This image shows how the Warp transform is influenced by the location of the cursor.



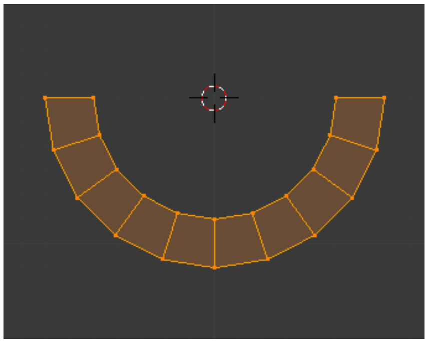


Warp Angle 180.

Before.

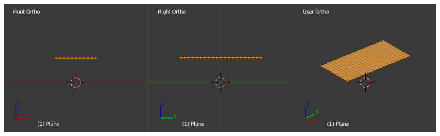


Before.

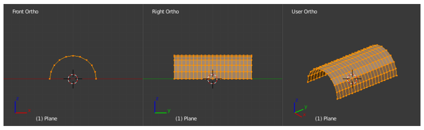


Warp Angle 180.

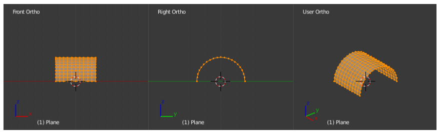
This image shows the influence of the current view.


Front Ortho
Right Ortho
User Ortho
(1) Plane
(1) Plane
(1) Plane

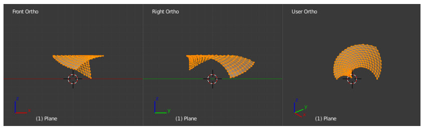
Before.


Front Ortho
Right Ortho
User Ortho
(1) Plane
(1) Plane
(1) Plane

Warp Angle 180 in XZ view.


Front Ortho
Right Ortho
User Ortho
(1) Plane
(1) Plane
(1) Plane

Warp Angle 180 in YZ view.


Front Ortho
Right Ortho
User Ortho
(1) Plane
(1) Plane
(1) Plane

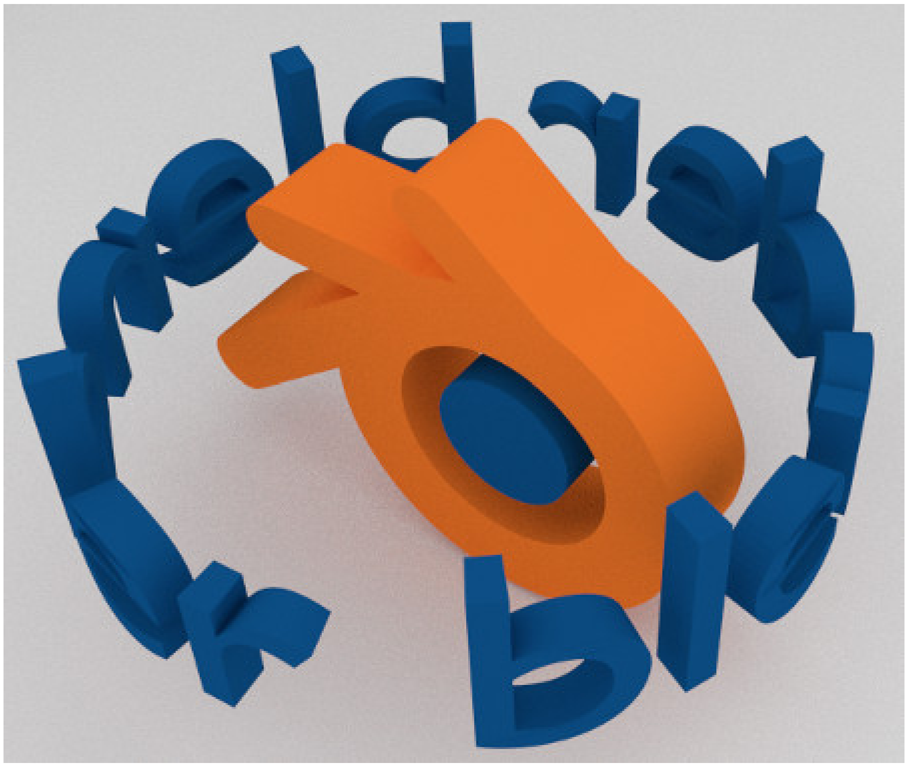
Warp Angle 180 in User view.

Note

Warping text

If you want to warp text, you will need to convert it from a text object to mesh using Convert.

Example



Text wrapped around logo.

This was made by creating the Blender logo and text as separate objects. The text was converted to a mesh and then warped around the Blender logo.

Randomize

Reference

Mode:: Edit Mode
Menu:: *Mesh* ‣ *Transform* ‣ *Randomize*

The *Randomize* tool in Edit Mode allows you to displace the vertices of a mesh along their normal.

Amount
  Distance of the displacement.

Uniform
  Adds a random offset of the amount.

Normal
  Adds a random offset to the displacement normal.

Random Seed
  The random seed is an offset to the random transformation. A different seed will produce a new result.

See also

Object Mode Randomize Transform

Shrink/Fatten

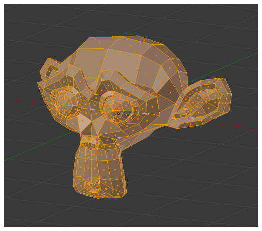
Reference

Mode:: Edit Mode
Tool:: *Toolbar ‣ Shrink/Fatten*
Menu:: *Mesh ‣ Transform ‣ Shrink/Fatten*
Shortcut:: `Alt-S`

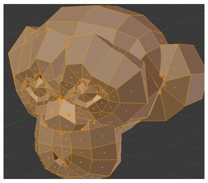
Moves the selected vertices "inwards" or "outwards" along their normal, all by the same distance. You can control this distance by moving the mouse up or down, typing a number, or using the slider in the Adjust Last Operation panel.

Even Thickness `S`, `Alt`

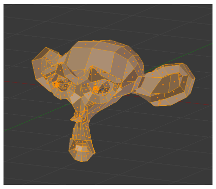
> Applies a larger offset to vertices that are part of a sharp corner, for a more uniform result. You can toggle this option by pressing `S`, holding `Alt`, or clicking the checkbox in the Adjust Last Operation panel.



Mesh before shrink/fatten.



Inflated using a positive value.



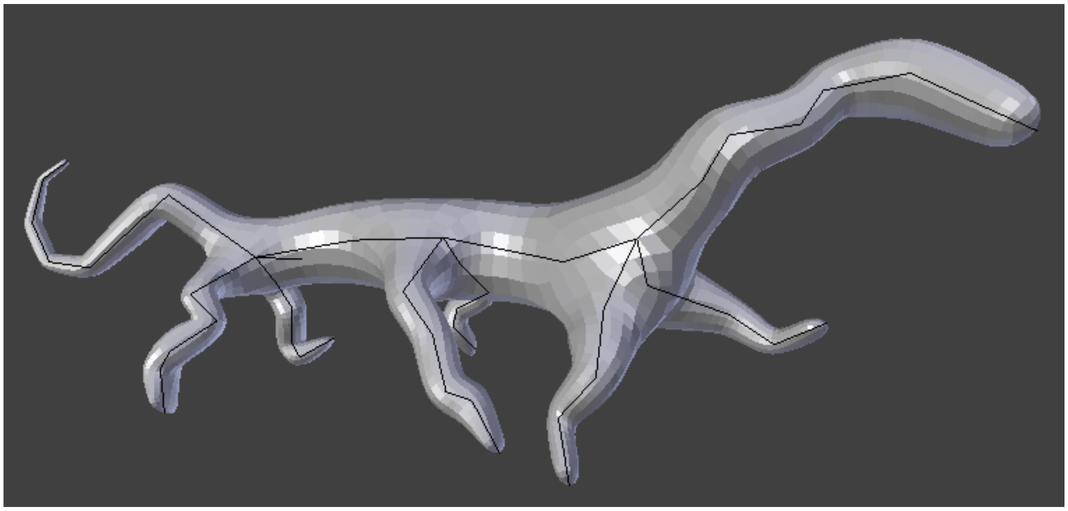
Shrunk using a negative value.

Skin Resize

Reference

Mode:: Edit Mode
Menu:: *Mesh ‣ Transform ‣ Skin Resize*
Shortcut:: `Ctrl-A`

This tool is used to set a skin radius per vertex when using a Skin Modifier. Non-uniform scaling of the X and Y axes is accessible by the usual axis locking with `X` or `Y`. The radius can also be adjusted in the *Transform* panel of the Sidebar, in the 3D Viewport. The mean radius of all vertices can be previewed in the 3D Viewport as a dashed circle around a vertex.



Simple creature, made with only the Skin and Subdivision Surface modifiers.

Mirror

Reference

Mode::	Edit Mode
Menu::	*Mesh ‣ Mirror*
Shortcut::	`Ctrl-M`

The Mirror tool mirrors a selection across a selected axis.

The Mirror tool in *Edit Mode* is similar to Mirroring in Object Mode. It is exactly equivalent to scaling vertices by -1 around one chosen pivot point and in the direction of one chosen axis, only it is faster/handier.

After this tool becomes active, select an axis to mirror the selection by pressing `X`, `Y`, or `Z`.

You can also interactively mirror the geometry by holding the `MMB` and dragging in the desired mirror direction.

Axis of Symmetry

For each transformation orientation, you can choose one of its axes along which the mirroring will occur.

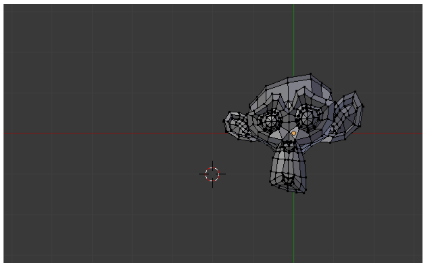
As you can see, the possibilities are infinite and the freedom complete: You can position the pivot point at any location around which we want the mirroring to occur, choose one transformation orientation and then one axis on it.

Pivot Point

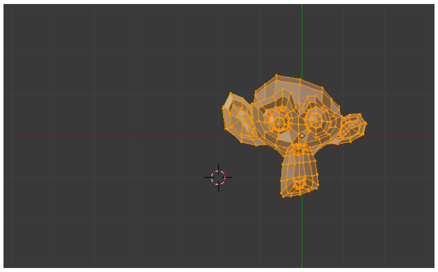
Pivot points must be set first. Pivot points will become the center of symmetry. If the widget is turned on it will always show where the pivot point is.

In Fig. Mirror around the individual origins. the pivot point default to median point of the selection of vertices in *Edit Mode*. This is a special case of the *Edit Mode* as explained on the pivot point page.

Mirror around the individual origins.



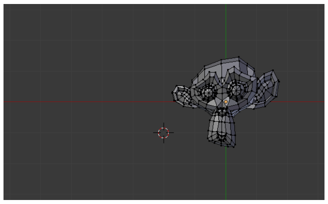
Mesh before mirror.



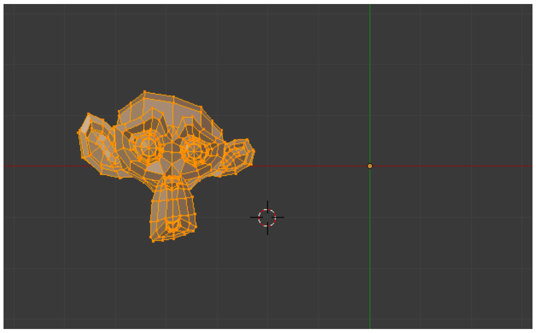
Mesh after mirrored along X axis.

In Fig. Mirror around the 3D Cursor. the pivot point is the *3D Cursor*, the transformation orientation is *Local*, a.k.a. the object space, and the axis of transformation is X.

Mirror around the 3D Cursor.



Mesh before mirror.



Mesh after mirrored along X axis using the 3D cursor as a pivot point.

Transformation Orientations

Transformation Orientations are found on the 3D Viewport header, next to the *Widget* buttons. They decide which coordinate system will rule the mirroring.

Duplicate

Reference

Mode:: Edit Mode
Menu:: *Mesh* ▸ *Duplicate*
Shortcut:: `Shift-D`

This tool simply duplicates the selected elements, without creating any connections with the rest of the mesh (unlike extrude, for example), and places the duplicate at the location of the original. Once the duplication is done, only the *new* duplicated elements are selected, and you are automatically placed in move mode, so you can move your copy elsewhere…

In the *Toolbar* are settings for *Vector* offset, *Proportional Editing*, *Duplication Mode*, and *Axis Constraints*.

Note that duplicated elements belong to the same vertex groups as the “original” ones. The same goes for the material indices, the edge’s *Sharp* and *Seam* marks, and probably for the other vertex/edge/face properties…

Extrude

Reference

Mode:: Edit Mode
Menu:: *Mesh ‣ Extrude*
Shortcut:: `Alt-E`

This operators shown in this menu are dependent of what part of a mesh is currently selected. Many of the operators are also available in the Vertex, Edge, abd Face menus.

Extrude Faces

Available when a Face is selected.

See Extrude Faces.

Extrude Faces Along Normals

Available when a Face is selected.

See Extrude Faces Along Normals.

Extrude Individual Faces

Available when a Face is selected.

See Extrude Individual Faces.

Extrude Manifold

Available when a Face is selected.

See Extrude Manifold.

Extrude Edges

Available when a Edge is selected.

See Extrude Edges.

Extrude Vertices

Available when a Vertex is selected.

See Extrude Vertices.

Extrude Repeat

Reference

Mode::	Edit Mode
Menu::	*Mesh* ▸ *Extrude* ▸ *Extrude Repeat*

This tool behaves similar to the Array Modifier, by extruding the selection along the Z axis of the view. If the selection is not Manifold it's extruded the specified number of times.

Offset X, Y, Z
  Distance between the instances.

Steps
  Number of instances.

Scale Offset
  Multiplication factor to increase or decrease the offset.

Spin

See Spin.

Merge

Reference

Mode::	Edit Mode
Menu::	*Mesh* ‣ *Merge*, *Context Menu* ‣ *Merge*
Shortcut::	`M`

This tool allows you to merge all selected vertices to a unique one, dissolving all others. You can choose the location of the remaining vertex in the menu this tool pops up before executing:

At Center
: It will place the remaining vertex at the center of the selection. Available in all select modes.

At Cursor
: It will place the remaining vertex at the 3D Cursor. Available in all select modes.

Collapse
: Every island of selected vertices (connected by selected edges) will merge on its own median center, leaving one vertex per island.

At First
: It will place the remaining vertex at the location of the first one selected. Only available in *Vertex* select mode.

At Last
: It will place the remaining vertex at the location of the last one selected (the active one). Only available in *Vertex* select mode.

Merging vertices of course also deletes some edges and faces. But Blender will do everything it can to preserve edges and faces only partly involved in the reunion.

Note

At First and *At Last* depend on that the selection order is saved: the order is lost, for instance, after changing selection mode.

UVs

If *UVs* is ticked in the Adjust Last Operation panel, the UV mapping coordinates, if existing, will be corrected to avoid image distortion.

By Distance

Todo.

Split

Reference

Mode::	Edit Mode
Menu::	*Mesh ‣ Split*
Shortcut::	`Alt-M`

Selection

Reference

Mode::	Edit Mode
Menu::	*Mesh ‣ Split ‣ Selection*
Shortcut::	`Y`

Splits (disconnects) the selection from the rest of the mesh. The border edge to any non-selected elements are duplicated.

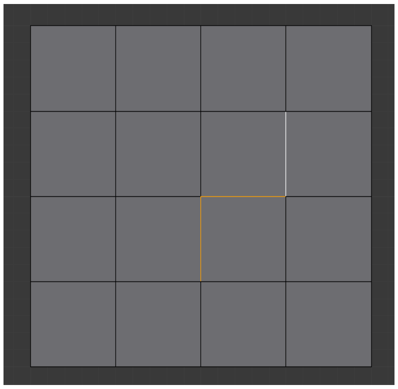
Note that the “copy” is left exactly at the same position as the original, so you must move it `G` to see it clearly…

Faces by Edges

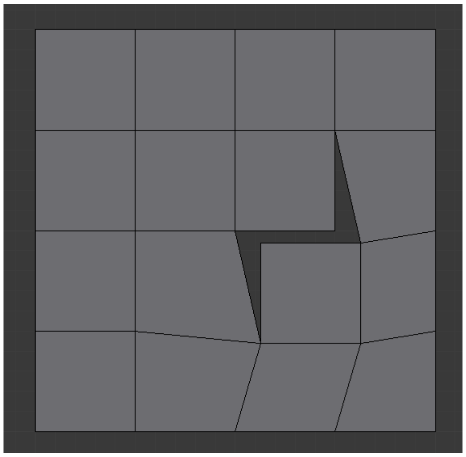
Reference

Mode::	Edit Mode
Menu::	*Mesh ‣ Split ‣ Faces by Edges*

Faces by Edges is similar to the *Rip* tool. When two or more touching interior edges, or a border edge is selected, a hole will be created, and the selected edges will be duplicated to form the border of the hole.



Selected edges.



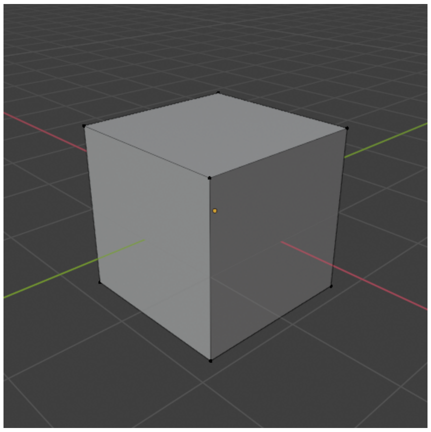
Adjacent face moved to reveal hole left by split.

Faces & Edges by Vertices

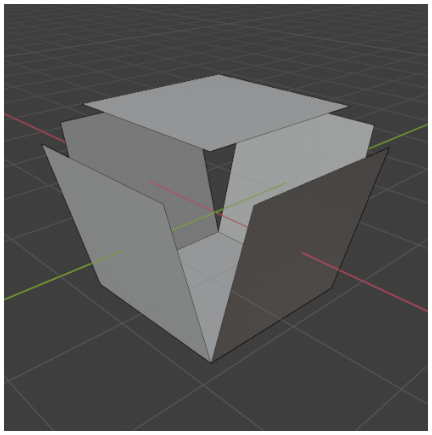
Reference

Mode::	Edit Mode
Menu::	*Mesh ‣ Split ‣ Faces & Edges by Vertices*

Faces & Edges by Vertices is similar to *Faces by Edges* except that it also splits the vertices of the adjacent connecting edges. This has the same functionality as manually ripping all faces and edges away from a vertex.



Before.



After (also moving edges away).

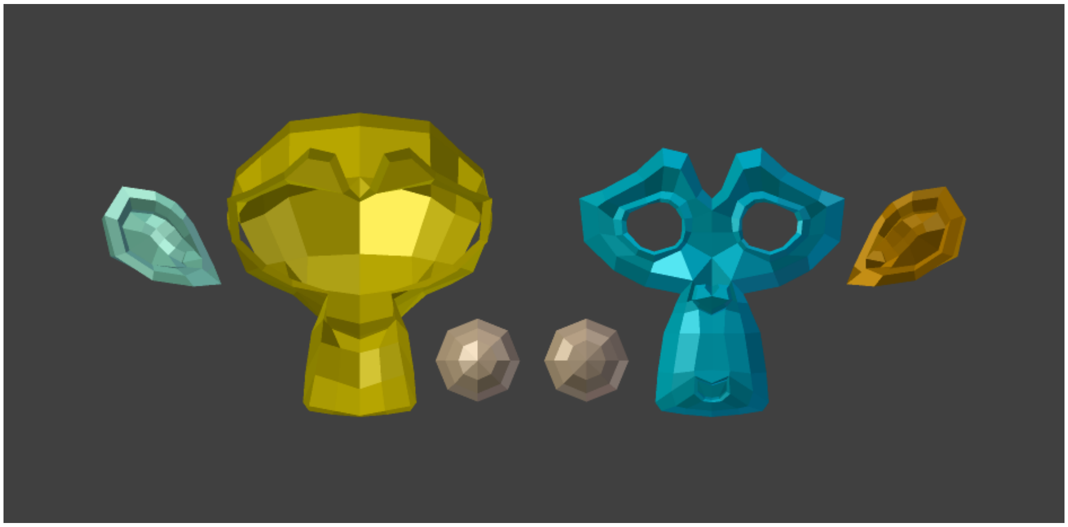
Separate

Reference

Mode:: Edit Mode
Menu:: *Mesh ‣ Separate*
Shortcut:: `P`

At some point, you will come to a time when you need to cut parts away from a mesh to be separate.

To separate an object, the vertices (or faces) must be selected and then separated, though there are several different ways to do this.



Suzanne dissected neatly.

Selection
: Separates the selected elements.

By Material
: Separates fragments based on the materials assigned to the different faces.

By Loose Parts

Creates one object for every independent (disconnected) fragment of the original mesh.

See also

Joining objects.

Bisect

Reference

Mode::	Edit Mode
Tool::	*Toolbar ‣ Knife ‣ Bisect*
Menu::	*Mesh ‣ Bisect*

The Bisect tool is a quick way to cut a mesh in two along a custom plane.

Use `LMB` click and drag to draw cut line. Once the cut is done the Adjust Last Operation panel gives a few options:

Plane Point, Plane Normal
  The plane can be numerically adjusted for precise values.

Fill
  Cuts can optionally fill in the holes created, with materials, UV maps, and Color Attributes based on the surrounding geometry.

Clear Inner, Clear Outer
  Cuts may remove geometry on one side.

Axis Threshold
  Cut along the straight plane or along the existing geometry below the distance from the plane.

Controls

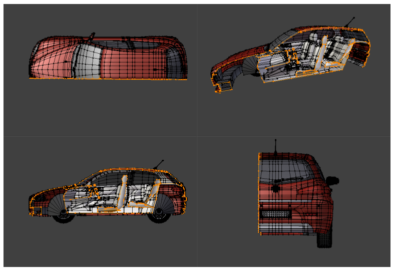
Move `Spacebar`
  Changes the location of the line.

Snap `Ctrl`
  Constrains the rotation of the line to 15 degree intervals.

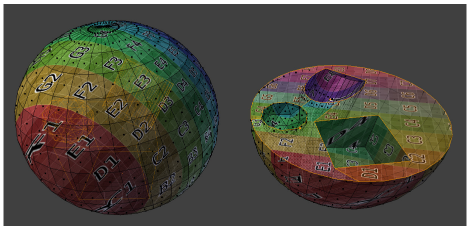
Flip `F`

Changes the side of the line that is the inner/outer side; this option is useful when using *Clear Inner*, *Clear Outer* and/or *Fill*.

Examples



Example of a common use of bisect.



Example of bisect with the fill option enabled.

Knife Project

Reference

Mode:: Edit Mode
Menu:: *Mesh* ▸ *Knife Project*

Knife Project is a non-interactive tool where you can use objects to cookie-cut into one or more meshes rather than hand drawing the line. The outline of the selected objects that *are not* in Edit Mode is projected along the view axis onto the meshes that *are* in Edit Mode, and then cuts into the faces there. Afterwards, the resulting geometry inside the cut gets selected.

Note

The cutting objects must be curves or non-manifold meshes (e.g. flat shapes, loose edges). Select Non-Manifold will highlight the cutting edges of mesh objects.

Keep in mind that Knife Project works from the current view's perspective. For best results, make sure to rotate your view to exactly the position you require before using this tool. Orthographic views such as Right, Front, and Top are commonly used for this.

Hint

3D Viewport Alignment to adjust the projection axis.

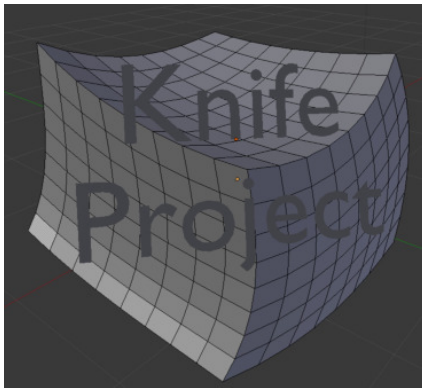
To use Knife Project, select the objects to be cut, switch to *Edit Mode*, select the cutting objects in the Outliner (`Ctrl-LMB`), and choose *Mesh* ▸ *Knife Project*.

If Blender switches back to *Object Mode* when selecting the cutting objects, make sure that *Edit* ‣ *Lock Object Modes* is checked in the topbar. Alternatively, if you have only one cutting object, you can select it in the viewport with `Ctrl-LMB`.

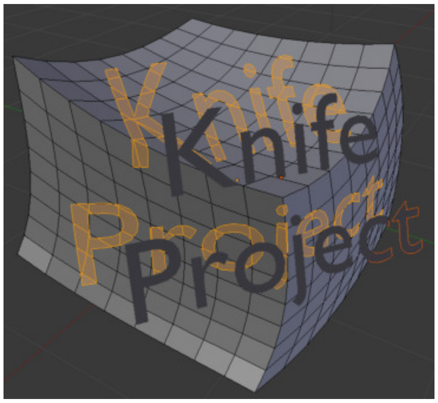
Options

Cut Through
: Projects the cut through the entire mesh, including back faces not currently visible.

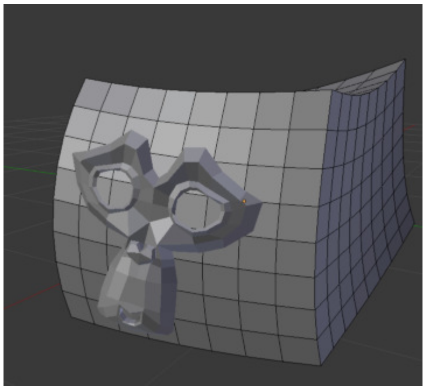
Examples

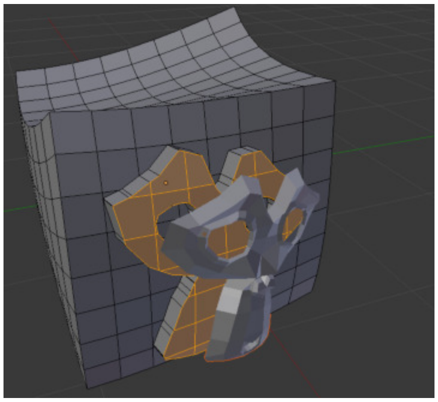


Before projecting from a text object.



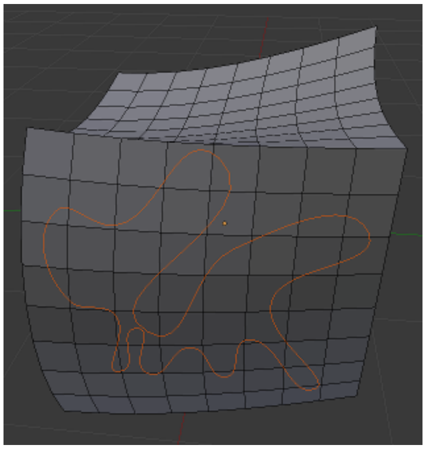
Resulting knife projection.



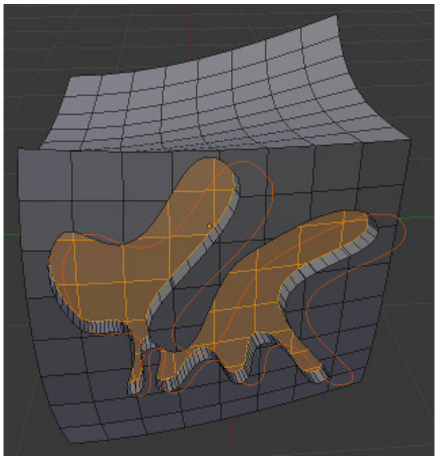


Before projecting from a mesh object.

Resulting knife projection (extruded after).



Before projecting from a 3D curve object.



Resulting knife projection (extruded after).

Known Limitations

When cutting multiple meshes in Edit Mode at once, geometry from these meshes does not occlude separate mesh objects behind them.

Knife Topology Tool

Reference

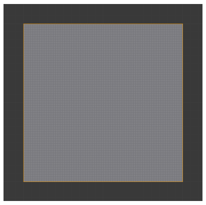
Mode:: Edit Mode
Tool:: *Toolbar ‣ Knife*
Menu:: *Mesh ‣ Knife Topology Tool*
Shortcut:: `K`

The Knife tool can be used to interactively subdivide (cut up) geometry by drawing lines or closed loops to create holes.

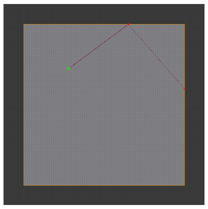
Usage

When using *Knife*, the cursor changes to an icon of a scalpel and the header changes to display options for the tool. You can draw connected straight lines by clicking `LMB`, marked with small green squares. Red squares are already defined cuts. Surrounding red squares mean that there is a cut already in that position, so no additional vertex will be created (besides the first one).

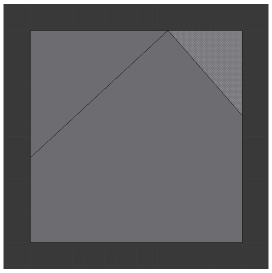
If multiple objects are selected before entering Edit Mode, then knife cuts will affect all of those objects.



Mesh before knife cut.



Knife cut active.



After confirming

knife cut.

Tool Settings

Occlude Geometry
: Only cut geometry visible on screen.

Only Selected `Shift-K`
: Only cuts through selected geometry.

X-Ray
: Show cut points on non-visible geometry too, when *Occlude Geometry* is deactivated.

Measurement
: Which visible measurements to show.

  Distance, Angle, None, Both

Angle Snapping
: Whether or not dragged lines should be constrained to particular angles, and if so, which coordinate system the angle is relative to.

  None, Screen, Relative

Angle Snapping Increment
: When angle snapping is on, the angle will be constrained to a multiple of this angle.

Controls

Confirm `Spacebar` or `Return`
: Confirms the cut. `Return` will leave selected every edge except the new edges created from the cut.

Cancel `Esc`

Cancels the cut.

Draw a Continuous Line `LMB` drag.

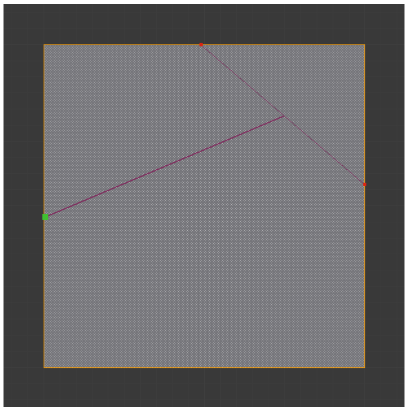
So you can draw a free-hand line over a surface, points will be created at edge intersections.

Close Loop double-click `LMB`

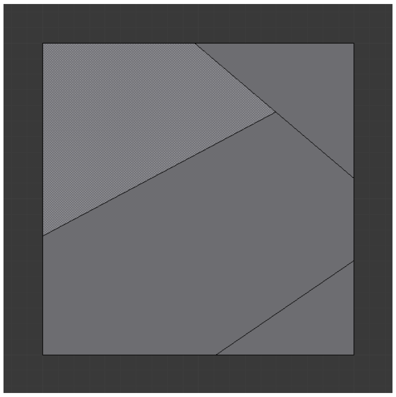
This is a quick way to close the loop you are currently cutting.

New Cut `RMB`

Begins a new cut. This allows you to define multiple distinct cut lines. If multiple cuts have been defined, they are recognized as new snapping points.



Creating multiple cuts.



Result of starting new cuts while in the tool.

Midpoint Snap `Shift`

Hold to snap the cursor to the midpoint of edges, meaning that all cuts will be performed at the exact center of each cut edge.

Ignore Snap `Ctrl`

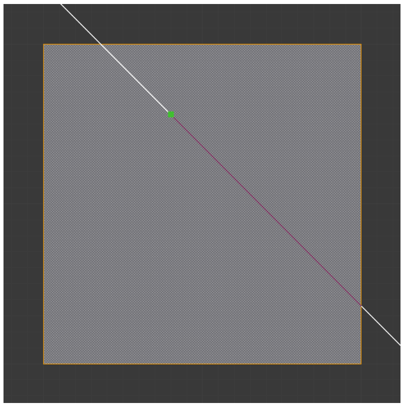
Hold to make the tool ignore snapping, unlike the default where mouse cursor snaps to near edges.

Cut Through: `C`

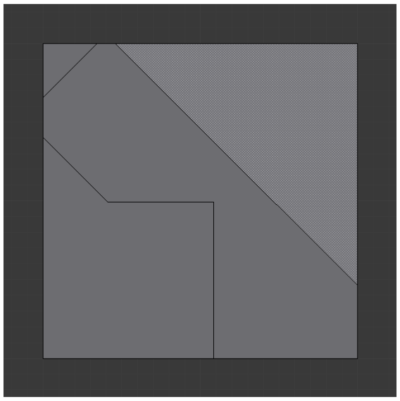
Allow the Cut tool to cut through to occluded faces, instead of only the visible ones.

Angle Constrain `A`

Constrains the cut line to certain degree increments. The increment can be specified in the Tool Settings (see above), or can be typed when angle constraining is active. The default angles are in the plane of the screen, but typing `A` again makes it relative to the last cut edge. If the last cut edge is ambiguous (because the cut was on a vertex), typing `R` cycles through the possible reference edges.



Constraining cut angle.



Result of constraining cut angle.

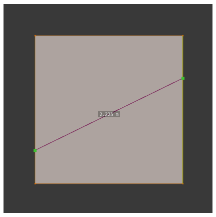
Axis Constrain `X`, `Y`, or `Z`

Constrains the cut line to one of the coordinate system axes. Initially it will be the global axis with the given name, but pressing the same key again switches to the object's local axis system. Additionally, if the scene transformation orientation is set to a custom orientation (e.g. from a face), the constraints will be in that coordinate system.

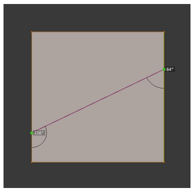
Visible Measurements `S`

Shows measurements of the cuts being made: angles with respect to a mesh edge, lengths, or both. Pressing `S` repeatedly cycles between what can be shown.

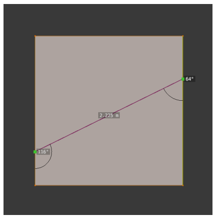
Only Distance, Only Angles, Both, None



Only Distance.



Only Angles.



Both Angles and Distance.

Undo `Ctrl-Z`

Undoes the previous cut segment. The starting point for the next cut is adjusted accordingly. If a cut is a drag cut, the entire drag cut is undone.

X-Ray Mode `V`

Toggles whether or not cuts to segments behind the visible geometry are shown.

Known Limitations

Duplicate Vertices

If you experience problems where duplicate vertices are being created by cuts, this is often caused by too large a near/far clipping range.

Try increasing the *Clip Start* to avoid this problem, see Depth Troubleshooting for details.

Unconnected Cuts

Cuts that begin or end in the middle of a face, will be ignored.

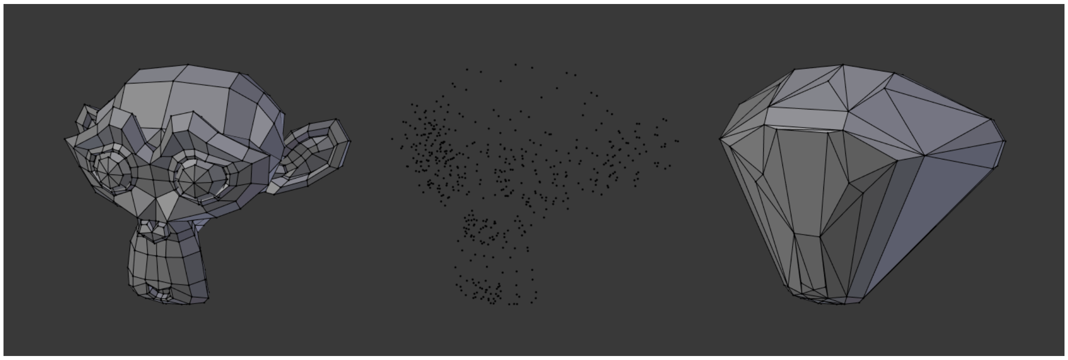
This is constrained by the kinds of geometry Blender can represent.

Convex Hull

Reference

Mode:: Edit Mode
Menu:: *Mesh ‣ Convex Hull*

The Convex Hull operator takes a point cloud as input and outputs a convex hull surrounding those vertices. If the input contains edges or faces that lie on the convex hull, they can be used in the output as well. This operator can be used as a bridge tool as well.



Input mesh, point cloud, and Convex Hull result.

Delete Unused
: Removes vertices, edges, and faces that were selected, but not used as part of the hull. Note that vertices and edges that are used by other edges and faces not part of the selection will not be deleted.

Use Existing Faces
: Where possible, use existing input faces that lie on the hull. This allows the convex hull output to contain n-gons rather than triangles (or quads if the *Join Triangles* option is enabled).

Make Holes

Delete edges and faces in the hull that were part of the input too. Useful in cases like bridging to delete faces between the existing mesh and the convex hull.

Join Triangles

Joins adjacent triangles into quads. Has all the same properties as the *Tris to Quads* operator (angle limit, compare UVs, etc.).

Max Face Angle, Max Shape Angle, Compare

See Triangles to Quads.

Symmetrize

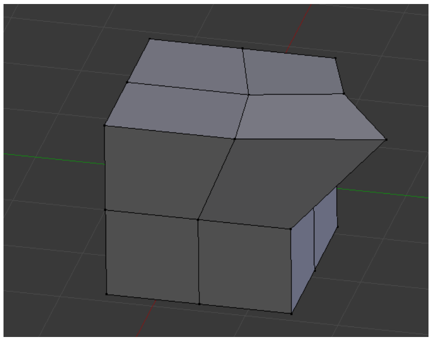
Reference

Mode::	Edit Mode
Menu::	*Mesh ‣ Symmetrize*

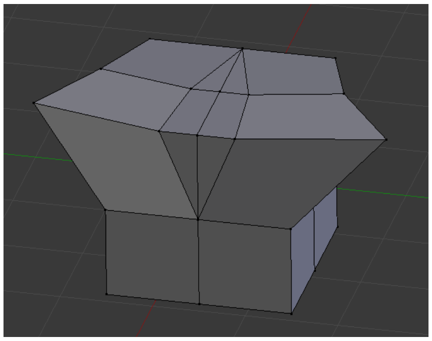
The *Symmetrize* tool is a quick way to make a mesh symmetrical. *Symmetrize* works by cutting the mesh at the pivot point of the object, and mirroring over the geometry in the specified axis, and merges the two halves together (if they are connected). Also the mesh data is copied from one side to the other: e.g. UVs, colors attributes, vertex weights.

Direction
: Specify the axis and direction of the effect. Can be any of the three axes, and either positive to negative, or negative to positive.

Threshold
: The vertices in this range will be snapped to the plane of symmetry.



Mesh before Symmetrize.



Mesh after Symmetrize.

See also

See Mirror for information on mirroring, which allows you to flip geometry across an axis.

Snap to Symmetry

Reference

Mode::	Edit Mode
Menu::	*Mesh ‣ Snap to Symmetry*

The Snap to Symmetry tool lets you snap a mesh vertices to their mirrored neighbors.

Useful when dealing with meshes which are mostly symmetrical, but have vertices which have been moved enough that Blender does not detect them as mirrored (when X Mirror option is enabled for example).

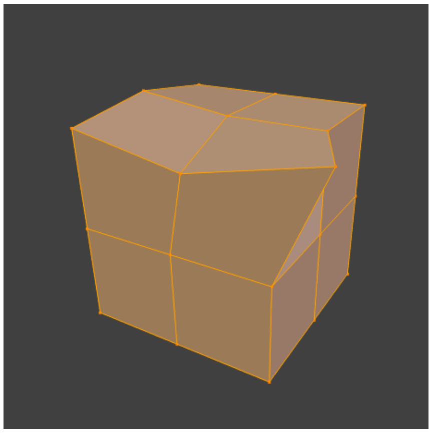
This can be caused by accident when editing without X Mirror enabled. Sometimes models imported from other applications are asymmetrical enough that mirror fails too.

Direction
: Specify the axis and direction to snap. Can be any of the three axes, and either positive to negative, or negative to positive.

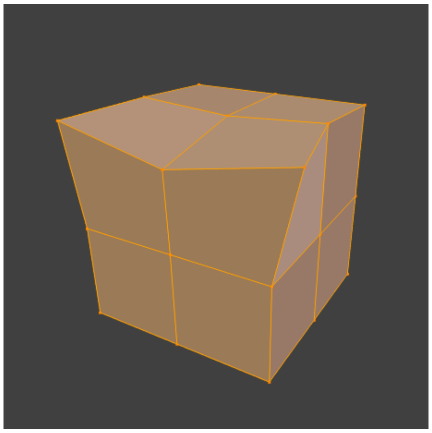
Threshold
: Specify the search radius to use when finding matching vertices.

Factor
: Support for blending mirrored locations from one side to the other (0.5 is an equal mix of both).

Center
: Snap vertices along the center axis to zero.



Before Snap to Symmetry.



After Snap to Symmetry.

Normals

See also

The Normal Edit Modifier can be used to edit normals.

The Weighted Normal Modifier can be used to affect normals by various methods, including *Face Strength* (see below).

You can also copy normals from another mesh using Mesh Data Transfer (operator or modifier).

Flip

Reference

Mode::	Edit Mode
Menu::	*Mesh* ‣ *Normals* ‣ *Flip*

This will reverse the normals direction of all selected faces. Note that this allows you to precisely control the direction (**not** the orientation, which is always perpendicular to the face) of your normals, as only the selected faces are flipped.

Recalculate

Reference

Mode::	Edit Mode
Menu::	*Mesh* ‣ *Normals* ‣ *Recalculate Outside* and *Mesh* ‣ *Normals* ‣ *Recalculate Inside*
Shortcut::	`Shift-N` and `Shift-Ctrl-N`

These tools will recalculate the normals of selected faces so that they point outside (respectively inside) the volume that the face belongs to. The volume does not need to be closed; inside and outside are determined by the angles with adjacent faces. This means that the face of interest must be adjacent to at least one non-coplanar other face. For example, with a *Grid* primitive, recalculating normals does not have a meaningful result.

Set from Faces

Reference

Mode::	Edit Mode
Menu::	*Mesh ‣ Normals ‣ Set from Faces*

Set the custom normals at corners to be the same as the face normal that the corner is part of.

Rotate

Reference

Mode::	Edit Mode
Menu::	*Mesh ‣ Normals ‣ Rotate*
Shortcut::	`R N`

This is an interactive tool. As you move the mouse around, the selected normals are rotated. You can also invoke the Rotate Normals tool by pressing the Rotate transform key `R`, followed by `N`.

Point to Target

Reference

Mode::	Edit Mode
Menu::	

Mesh ‣ Normals ‣ Point to Target

Shortcut:: `Alt-L`

All selected normals are set to point from their vertex to the target after confirmed by `Return` or `LMB`.

A target is set by the keys:

- The mouse cursor `M`
- The pivot `L`
- The object origin `O`
- The cursor (set at this click) `Ctrl-LMB`
- A mesh item selection (set by this click) `Ctrl-RMB`

Mode

The tool operation can be modified; if one of the following keys has been previously pressed:

Align `A`

All normals will point in the same direction: from the center of selected points to the target.

Spherize `S`

Each normal will be an interpolation between its original value and the direction to the target.

Invert `I`

The normal directions are reversed from what was specified above.

Reset `R`

Will reset the custom normals back to what they were when the operation started.

Merge

Reference

Mode:: Edit Mode
Menu:: *Mesh ‣ Normals ‣ Merge*

Merge all of the normals at selected vertices, making one average normal for all of the faces.

Split

Reference

Mode:: Edit Mode
Menu:: *Mesh ‣ Normals ‣ Split*

Split the normals at all selected vertices so that there are separate normals for each face, pointing in the same direction as those faces.

Average

Reference

Mode:: Edit Mode
Menu:: *Mesh ‣ Normals ‣ Average*

Average all of the normals in each fan of faces between sharp edges at a vertex.

Copy Vectors

Reference

Mode:: Edit Mode
Menu:: *Mesh ‣ Normals ‣ Copy Vectors*

If a single normal is selected, copy it to an internal vector buffer.

Paste Vectors

Reference

Mode:: Edit Mode
Menu:: *Mesh ▸ Normals ▸ Paste Vectors*

Replace the selected normals with the one in the internal vector buffer.

Smooth Vectors

Reference

Mode:: Edit Mode
Menu:: *Mesh ▸ Normals ▸ Smooth Vectors*

Adjust the normals to bring them closer to their adjacent vertex normals.

Reset Vectors

Reference

Mode:: Edit Mode
Menu:: *Mesh ▸ Normals ▸ Reset Vectors*

Put normals back the to default calculation of the normals.

Select by Face Strength

Reference

Mode:: Edit Mode
Menu:: *Mesh ▸ Normals ▸ Select by Face Strength*

Another way to affect normals is to set a *Face Strength* on the faces of the model. The Face Strength can be either *Weak*, *Medium*, or *Strong*. The idea is that the Weighted Normal Modifier can be set to pay attention to the Face Strength as follows: When combining the normals that meet at a vertex, only the faces with the strongest Face Strength will contribute to the final value.

For example, if three faces meet at a vertex and have the face weights weak, medium, and strong, then only the normal associated with the strong face will be used to set the final result.

Use the submenu to pick one of *Weak*, *Medium*, or *Strong*. Then this tool selects those faces that have the chosen face strength.

Set Face Strength

Reference

Mode:: Edit Mode
Menu:: *Mesh* ▸ *Normals* ▸ *Set Face Strength*

Use the submenu to pick one of *Weak*, *Medium*, or *Strong*. Then this tool changes the Face Strength of currently selected faces to the chosen face strength.

Shading

Reference

Mode::	Edit Mode
Menu::	*Mesh ▸ Shading*

Alternatively, you can choose which faces to smooth by entering *Edit Mode*, then selecting some faces and picking *Shade Smooth* from the *Face Menu*.

When the mesh is in *Edit Mode*, only the selected faces will receive the “smoothing” attribute. You can set faces as flat (removing the “smoothing” attribute) in the same way by selecting edges and picking the *Shade Flat* from the *Face Menu*.

Set Attribute

Reference

Mode:: Edit Mode
Menu:: *Mesh ‣ Set Attribute*

Sets the value of the Active Attribute for the selected element. “Active attribute” here means the attribute that is currently selected in the Attributes list.

When the operator is executed a pop-up window will display the attribute’s name and current value. From here, the value field came be adjusted to change the attribute’s value.

See also

Attribute values can be viewed in the Spreadsheet editor.

Sort Elements

Reference

Mode:: Edit Mode
Menu:: *Mesh ‣ Sort Elements…*

This tool (available from the context menu, *Vertices*, *Edges* and *Faces* menus) allows you to reorder the matching selected mesh elements, following various methods. Note that when called from the context menu, the affected element types are the same as the active select modes.

View Z Axis
: Sort along the active view's Z axis, from farthest to nearest by default (use *Reverse* if you want it the other way).

View X Axis
: Sort along the active view's X axis, from left to right by default (again, there is the *Reverse* option).

Cursor Distance
: Sort from nearest to farthest away from the 3D cursor position (*Reverse* also available).

Material
: Sort faces, and faces only, from those having the lowest material's index to those having the highest. Order of faces inside each of those "material groups" remains unchanged. Note that the *Reverse* option only reverses the order of the materials, *not* the order of the faces inside them.

Selected
: Move all selected elements to the beginning (or end, if *Reverse* enabled), without affecting their relative orders. Warning: This option will also affect **unselected** elements' indices!

Randomize

Randomizes indices of selected elements (*without* affecting those of unselected ones). The seed option allows you to get another randomization – the same seed over the same mesh or set of selected elements will always give the same result!

Reverse

Simply reverse the order of the selected elements.

Hint

Enabling the Display Indices Option

Enable the *Developer Extras* Option in *Preferences ‣ Interface ‣ Display* panel, a checkbox will appear in *Display & Shading Menu ‣ Viewport Overlay ‣ Developer ‣ Indices*.

Clean Up

These tools are to help cleanup degenerate geometry and fill in missing areas of a mesh.

Decimate Geometry

Reference

Mode::	Edit Mode
Menu::	*Mesh* ▸ *Clean up* ▸ *Decimate Geometry*

The Decimate Geometry tool allows you to reduce the vertex/face count of a mesh with minimal shape changes.

Ratio

Ratio of triangles to reduce to.

Vertex Group

Use the active vertex group as an influence.

Weight

Strength of the vertex group.

Invert

Inverts the vertex group.

Symmetry

Maintain symmetry on either the *X*, *Y*, or *Z* axis.

See also

This tool works similar to the Decimate Modifier.

Fill Holes

Reference

Mode::	Edit Mode
Menu::	*Mesh ‣ Clean up ‣ Fill Holes*

This tool can take a large selection and detect the holes in the mesh, filling them in.

This is different from the face creation operator in three important respects:

1. Holes are detected, so there is no need to manually find and select the edges around the holes.
2. Holes can have a limit for the number of sides (so only quads or tris are filled in for example).
3. Mesh data is copied from surrounding geometry (UVs, Color Attributes, multi-res, all layers), since manually creating this data is very time-consuming.

Make Planar Faces

Reference

Mode::	Edit Mode
Menu::	*Mesh ‣ Clean up ‣ Make Planar Faces*

The *Make Planar Faces* iteratively flattens faces. This can happen with faces over three vertices and it is a common convention that faces should be kept planar.

Factor
    Distance to move the vertices each iteration.

Iterations
    Number of times to repeat the operation.

Split Non-Planar Faces

Reference

Mode:: Edit Mode
Menu:: *Mesh ▸ Clean up ▸ Split Non-Planar Faces*

This tool avoids ambiguous areas of geometry by splitting non-flat faces when they are bent beyond a given limit.

Split Concave Faces

Reference

Mode:: Edit Mode
Menu:: *Mesh ▸ Clean up ▸ Split Concave Faces*

This tool can be used to convert any Concave Face to convex by splitting the concave into two or more convex faces.

Delete Loose

Reference

Mode:: Edit Mode
Menu:: *Mesh ▸ Clean up ▸ Delete Loose*

This tool removes disconnected vertices and edges (optionally faces).

Degenerate Dissolve

Reference

Mode:: Edit Mode

Menu::	*Mesh ‣ Clean up ‣ Degenerate Dissolve*

This tool collapses / removes geometry which you typically will not want.

- Edges with no length.
- Faces with no areas (faces on a point or thin faces).
- Face corners with no area.

Merge by Distance

Reference

Mode::	Edit Mode
Menu::	*Vertex ‣ Merge by Distance*, *Context Menu ‣ Merge by Distance*

Merge by Distance is a useful tool to simplify a mesh by merging the selected vertices that are closer than a specified distance to each other. An alternative way to simplify a mesh is to use the Decimate Modifier.

Merge Distance
   Sets the distance threshold for merging vertices.

Unselected
   Allows vertices in the selection to be merged with unselected vertices. When disabled, selected vertices will only be merged with other selected ones.

Deleting & Dissolving

Reference

Mode:: Edit Mode
Menu:: *Mesh ‣ Delete*

These tools can be used to remove components.

Delete

Reference

Shortcut:: `X`, `Delete`

Deletes selected vertices, edges, or faces. This operation can also be limited to:

Vertices
    Delete all vertices in current selection, removing any faces or edges they are connected to.

Edges
    Deletes any edges in the current selection. Removes any faces that the edge shares with it.

Faces
    Removes any faces in current selection.

Only Edges & Faces
    Limits the operation to only selected edges and adjacent faces.

Only Faces
    Removes faces, but edges within the face selection are retained.

Dissolve

Dissolve operations are also accessed from the delete menu. Dissolve will remove the geometry and fill in the surrounding geometry. Instead of removing the geometry, which may leave holes that you have to fill in again.

Removes selected geometry, but without creating holes, effectively turning the selection into a single n-gon. Dissolve works slightly different based on if you have edges, faces or vertices selected. You can add detail where you need it, or quickly remove it where you do not.

Dissolve Vertices

Reference

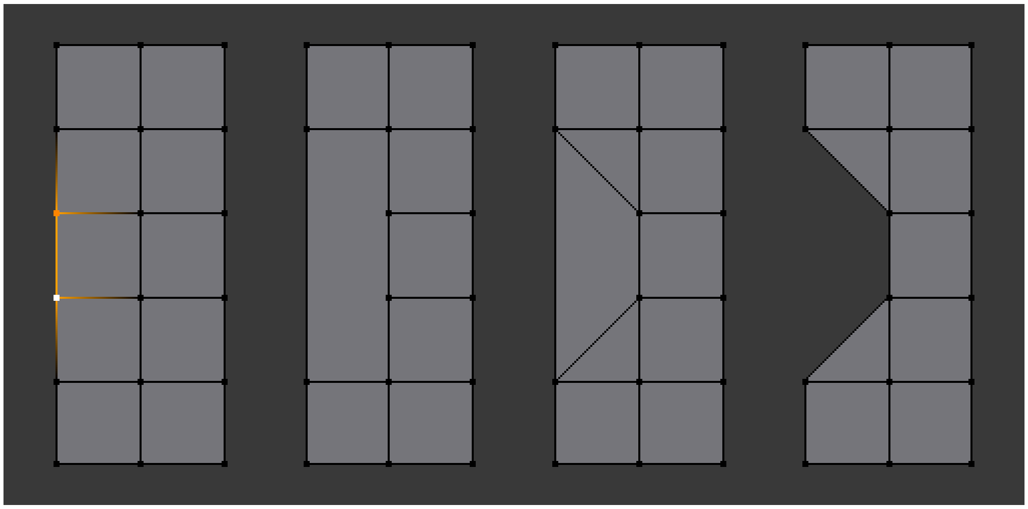
Mode::	Edit Mode
Menu::	*Mesh* ▸ *Delete* ▸ *Dissolve Vertices*

Remove the vertex, merging all surrounding faces. In the case of two edges, merging them into a single edge.

Face Split
: When dissolving vertices into surrounding faces, you can often end up with very large, uneven n-gons. The face split option limits dissolve to only use the corners of the faces connected to the vertex.

Tear Boundaries
: Split off face corners instead of merging faces.

Examples



1) Original mesh. 2) Face Split: Off, Tear Boundaries: Off. 3) Face Split: On, Tear Boundaries: Off. 4) Face Split: On/Off, Tear Boundaries: On.

Dissolve Edges

Reference

Mode::	Edit Mode
Menu::	*Mesh* ‣ *Delete* ‣ *Dissolve Edges*

Removes edges sharing two faces (joining those faces).

The options are the same as for the Dissolve Vertices tool.

Dissolve Faces

Reference

Mode::	Edit Mode
Menu::	*Mesh* ‣ *Delete* ‣ *Dissolve Faces*

Merges regions of faces that share edges into a single face.

Note

This can be accessed quickly using the `F` key, see: Dissolve Existing Faces.

Dissolve (Context-Sensitive)

Reference

Shortcut:: `Ctrl-X`

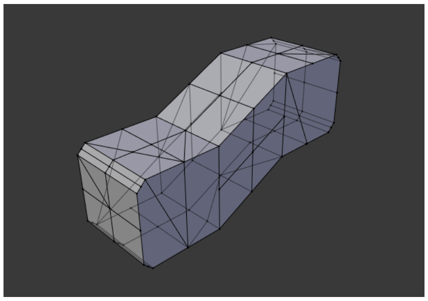
This is a convenient shortcut that dissolves based on the current selection mode (vertex, edge, face).

Limited Dissolve

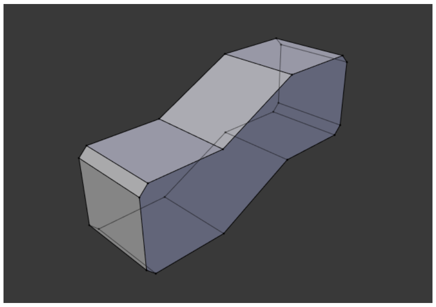
Reference

Mode:: Edit Mode
Menu:: *Mesh ‣ Delete ‣ Limited Dissolve*

This tool can simplify your mesh by dissolving vertices and edges separating flat regions.



Original mesh.



Result of Limited Dissolve.

Max Angle
    Reduces detail on planar faces and linear edges with an adjustable angle threshold.

All Boundaries
    Always dissolve vertices that have two edge users at boundaries.

Delimit
    Prevent faces from joining when they don’t share certain properties (material for e.g.).

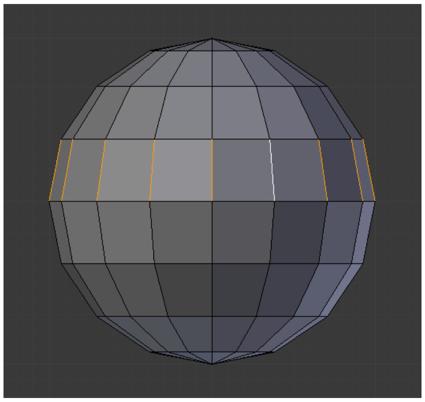
Collapse Edges & Faces

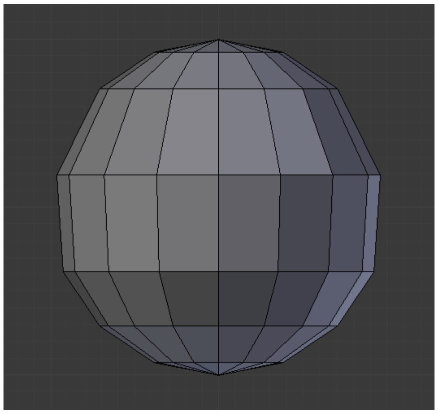
Reference

Mode::	Edit Mode
Menu::	*Mesh ▸ Delete ▸ Collapse Edges & Faces*
Shortcut::	`X`, *Collapse Edges & Faces*

Collapse each isolated edge and face region into single vertices, with support for face data such as UVs and vertex colors.

This is useful for taking a ring of edges and collapsing it, removing the face loop it ran through.





Selected edge ring.	Edge ring collapsed.

Tip

This can be useful as a general way to remove detail, it has some advantages over:

Delete Vertices::	Leaves holes.
Collapse Vertices::	Doesn’t correct UVs, vertex colors, etc.
Dissolve Vertices::	Often creates n-gons.

Edge Loops

Reference

Mode::	Edit Mode (Vertex or Edge select modes)
Menu::	*Mesh ‣ Delete ‣ Edge Loops*
Shortcut::	`X` or `Delete`, *Edge Loops*

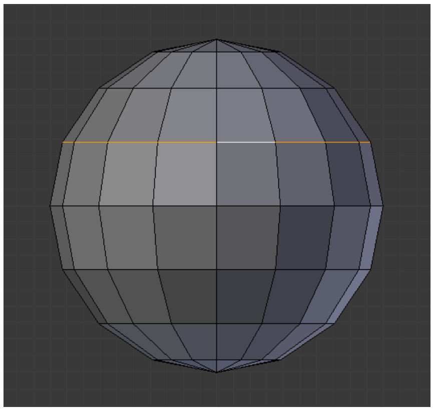
Edge Loop allows you to delete a selected edge loop if it is between two other edge loops. This will create one face loop where two previously existed.

Note

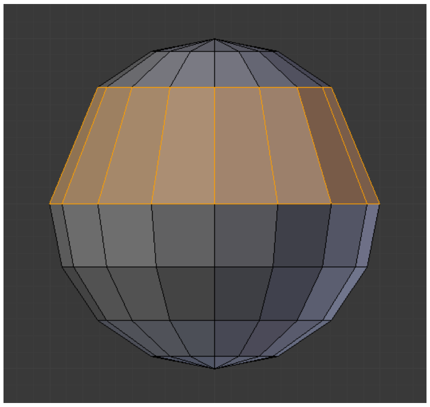
The *Edge Loop* option is very different to the *Edges* option, even if you use it on edges that look like an edge loop. Deleting an edge loop merges the surrounding faces together to preserve the surface of the mesh. By deleting a chain of edges, the edges are removed, deleting the surrounding faces as well. This will leave holes in the mesh where the faces once were.

Example

The selected edge loop on the UV Sphere has been deleted and the faces have been merged with the surrounding edges. If the edges had been deleted by choosing *Edges* from the *Delete* menu there would be an empty band of deleted faces all the way around the sphere instead.



Selected edge loop.



Edge loop deleted.

See also

- Vertex merging.
- Triangles to Quads.
- Un-Subdivide.

Vertex Operators

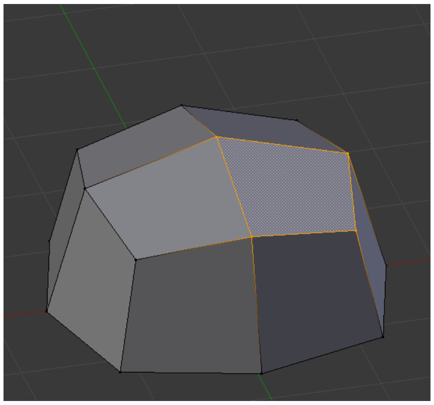
- Extrude Vertices
- Extrude to Cursor or Add
    - Creating Faces
- Bevel Vertices
    - Options
- New Edge/Face from Vertices
    - Methods
- Connect Vertex Path
- Connect Vertex Pairs
- Rip Vertices
    - Examples
    - Limitations
- Rip Vertices and Fill
- Rip Vertices and Extend
- Slide Vertices
- Smooth Vertices
- Laplacian Smooth
- Blend from Shape
- Propagate to Shapes
- Vertex Groups
- Hooks
- Make Vertex Parent

Extrude Vertices

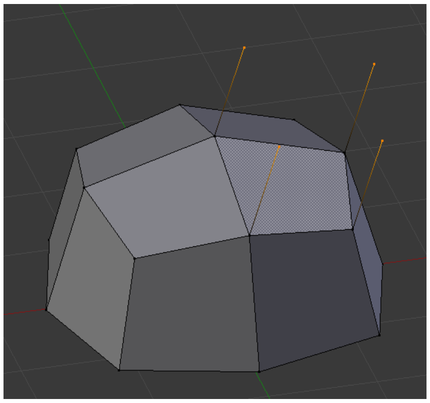
Reference

Mode:: Edit Mode
Menu:: *Vertex ▸ Extrude Vertices*, *Mesh ▸ Extrude ▸ Extrude Vertices*
Shortcut:: `E`

Extrude vertices as individual vertices.



Vertex selected.



Vertices extrude.

Extrude to Cursor or Add

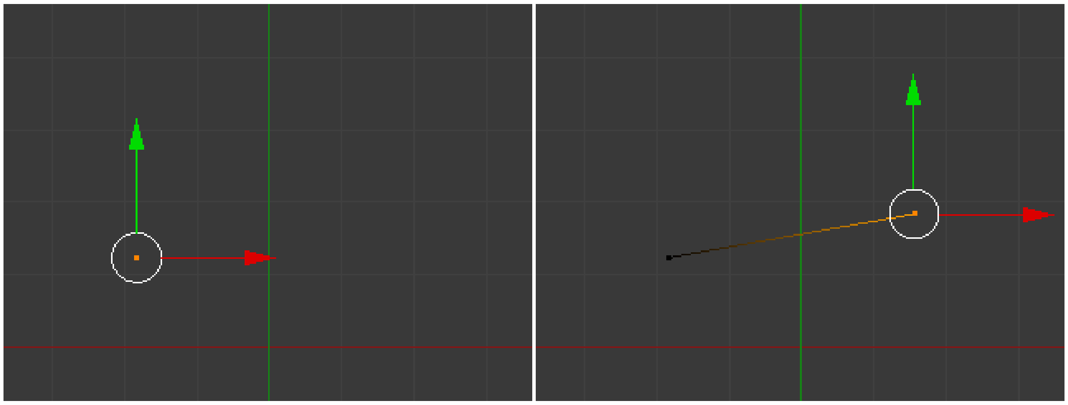
Reference

Mode:: Edit Mode
Shortcut:: `Ctrl-RMB`

Interactively places new vertices with `Ctrl-RMB` at the mouse cursor position.

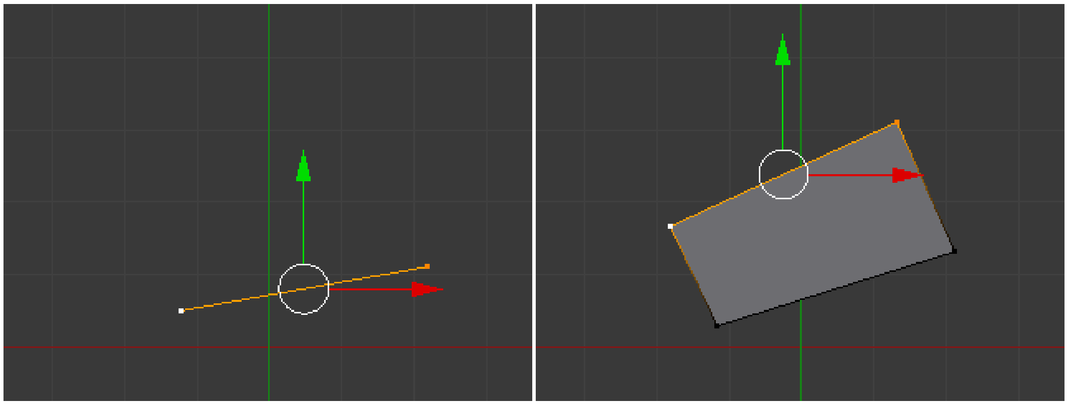
The most basic element, a vertex, can be added with a `Ctrl-RMB` click when no other vertices are selected. Because the camera space (computer screen) is two-dimensional, Blender cannot determine all three vertex coordinates from a single mouse click, so the new vertex is placed at the depth of the 3D cursor.

To create interconnected vertices, you can add a vertex and continuously make subsequent `Ctrl-RMB` operations with the last vertex selected. This will link the last selected vertex with the vertex created at the mouse position with an edge (see Fig. Adding vertices one by one.), and will continuously create and connect new vertices if you continue repeating this operation.



Adding vertices one by one.

Creating Faces



Quad from an Edge with source automatically rotated.

If you have two vertices selected and already connected with an edge, `Ctrl-RMB` click will create a planar face, also known as a quad. Blender will follow your mouse cursor and will use the planar view from your viewport to create those quads.

For `Ctrl-RMB`, Blender will automatically rotate the last selected Edge (the source) for the subsequent operations if you have at least one face created, dividing the angles created between the newly created edge and the last two edges, creating a smooth angle between them. Blender will calculate this angle using the last positive and negative position of the last X and Y coordinates and the last connected unselected edge. If this angle exceeds a negative limit (following a quadrant rule) between the recently created edge and the last two, Blender will wrap the faces. But if you do not want Blender to rotate and smooth edges automatically when extruding from `Ctrl-RMB`, you can also inhibit Blender from rotating sources using the shortcut `Shift-Ctrl-RMB`. In this case, Blender will not rotate the source dividing the angle between those edges when creating a face.

If you have three or more vertices selected, and `Ctrl-RMB` click, you will also create planar faces, but along the vertices selected, following the direction of the cursor. This operation is similar to an extrude operation.

Tip

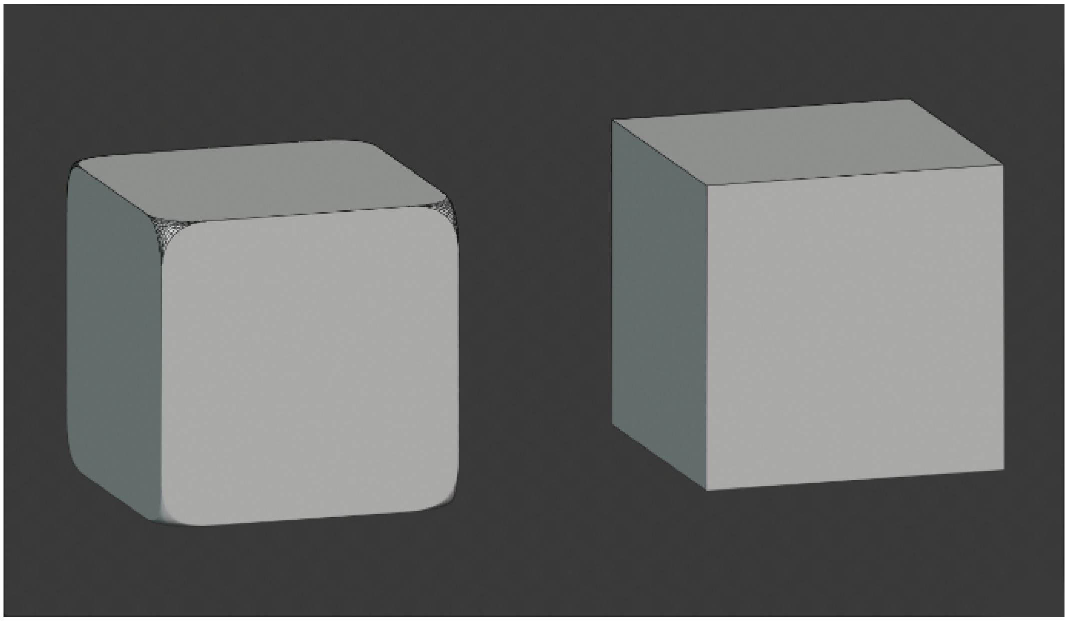
When adding objects with `Ctrl-RMB`, the extrusions of the selected elements, being vertices, edges and faces with the `Ctrl-RMB`, are viewport dependent. This means, once you change your viewport, for example, from top to left, bottom or right, the extrusion direction will also follow your viewport and align the extrusions with your planar view.

Bevel Vertices

Reference

Mode::	Edit Mode
Menu::	*Edge ‣ Bevel Edges*
Shortcut::	`Ctrl-B` (Bevel Edges)
Menu::	*Vertex ‣ Bevel Vertices*
Shortcut::	`Shift-Ctrl-B` (Bevel Vertices)

The *Bevel* tool rounds off edges or corners of a mesh at the point of the selected vertices. In “vertex only” mode, the *Bevel Vertices* tool works on selected vertices but the option to switch to *Bevel Edges* is available. By doing so, more vertices are added in order to smooth out profiles with a specified number of *segments* (see the options below for details about the bevel algorithm).



Cubes with and without bevel.

Note

With the Vertex Only option active, some of the other options available will not work. However, they will work with Bevel Edges.

Options

Affect `V`

Vertices::	Only the areas near vertices are beveled, the edges remain unchanged.
Edges::	Bevel the edges, creating intersections at vertices.

Offset `A`

You can change the bevel amount by moving the mouse towards and away from the object, like with transform tools. The exact meaning of the value depends on the *Amount Type* option (see below).

Width Type `M`

Selects how the *Amount* value controls the size of the bevel. According to the selection, the amount is:

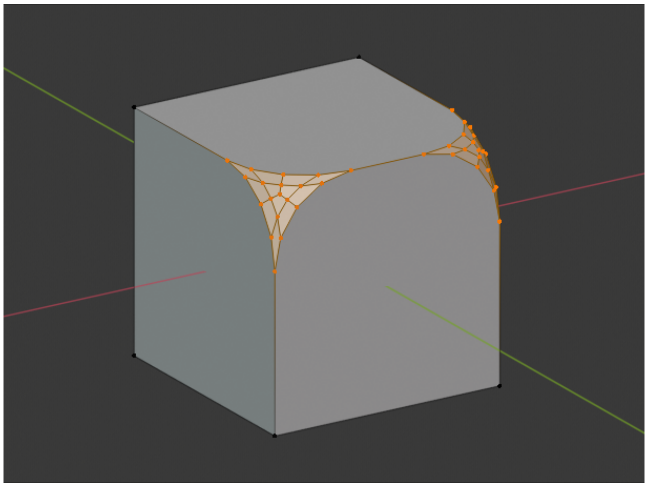
Offset::	The relative distance from the new edge to the original.
Width::	The distance between the two new edges formed by the bevel (or the edges on either side of the bevel if there is more than one segment).
Depth::	The perpendicular distance from the original edge to the bevel face.
Percent::	The percentage of the length of adjacent edges that the new edges are slid along.
Absolute::	The exact distance along edges adjacent to the beveled edge. A difference from *Offset* is visible when the unbeveled edges attached to beveled edges meet at an angle besides a right angle.

For vertex-only bevels, the Offset and Depth types measure from the original vertex, and the Width type is measured from a new vertex to the center of the new face (as half the amount).

Segments `S`

The number of segments in the bevel can be defined by scrolling the mouse `Wheel` to increase or decrease this value. The greater the number of segments, the smoother the bevel. Or press `S` to change the number with mouse movements, as well as numeric input.

Alternatively, you can manually enter a segment number value while using the tool, or in the Mesh Tool options panel after using the tool.



Bevel with four segments.

Shape `P`

This is a number between 0 and 1 that controls the shape of the profile (side view of a beveled edge). The default value, 0.5, gives a circular arc (if the faces meet at right angles). Values less than that give a flatter profile, with 0.25 being exactly flat, and values less than that giving a concave bevel. Values more than 0.5 give a more convex profile. Similarly as *Segments* it can be set with mouse movements and numeric input after toggling `P`.

Material Index

The *Material* number specifies which material should be assigned to the new faces created by the *Bevel* tool. With the default, -1, the material is inherited from the closest existing face ("closest" can be a bit ambiguous). Otherwise, the number is the slot index of the material to use for all newly created faces.

Harden Normals `H`

When enabled, the per-vertex face normals of the bevel faces are adjusted to match the surrounding faces, and the normals of the surrounding faces are not affected. This will keep the surrounding faces flat (if they were before), with the bevel faces shading smoothly into them. For this effect to work, a mesh must have custom split normals. As a convenience, that option will be enabled for you if it is not already when you enable Harden Normals here.

Clamp Overlap `C`

Limits the width of each beveled edge so that vertices do not overlap with other geometry.

Loop Slide

If there are un-beveled edges along with beveled edges into a vertex, the bevel tries to slide along those edges when possible. Turning the option off can lead to more even bevel widths.

Face Strength Mode

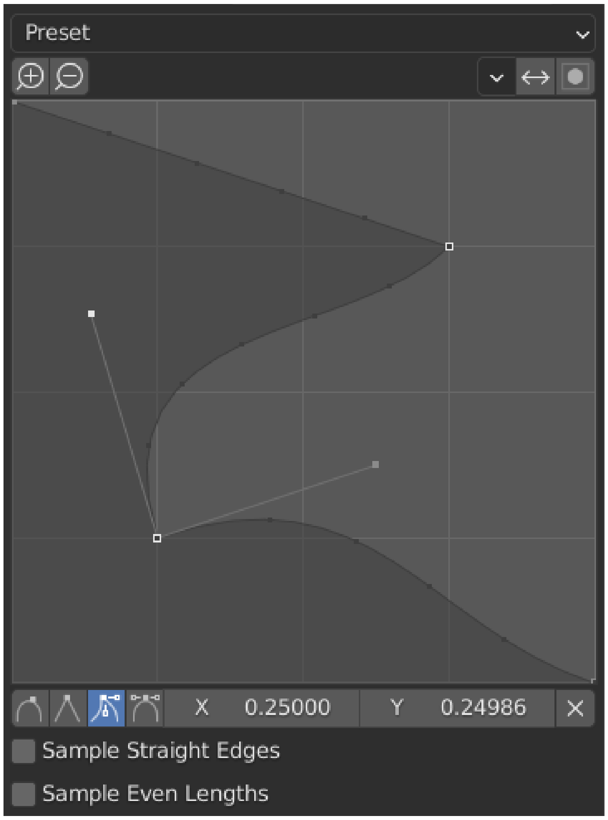
Set *Face Strength* on the faces involved in the bevel, according to the specified mode. This can be used in conjunction with a Weight Normals Modifier (with the *Face Influence* option checked).

None::	Do not set face strength.
New::	Set the face strength of new faces along edges to *Medium*, and the face strength of new faces at vertices to *Weak*.
Affected::	In addition to those set for the *New* case, also set the faces adjacent to new faces to have strength *Strong*.
All::	In addition to those set for the *Affected* option, also set all the rest of the faces of the model to have strength *Strong*.

Profile Type `Z`

Superellipse::	Creates a bevel with a uniform concave or convex curve.

Custom::



The custom profile widget.

This widget allows the creation of a user-defined profile with more complexity than with the single profile parameter. The modal tool allows toggling the custom profile, but the shape of the profile is only editable in the options panel after the operation is confirmed.

The profile starts at the bottom right of the widget and ends at the top left, as if it were between two edges intersecting at a right angle. Control points are created in the widget and then the path is sampled with the number of segments from the Bevel modifier.

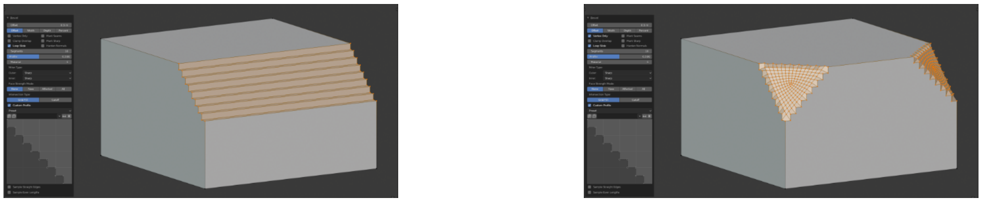
Presets

> The *Support Loops* and *Steps* presets are built dynamically depending on the number of segments in the bevel. If the number of segments is changed, the preset will have to be re-applied.

Sampling

Samples will first be added to each control point, then if there are enough samples, they will be divided evenly between the edges. The *Sample Straight Edges* option toggles whether the samples are added to edges with sharp control points on either side. If there aren’t enough samples to give each edge the same number of samples, they will just be added to the most curved edges. So it is recommended to use at least as many segments as there are control points.

Bevel with Custom Profile on.



Edge Bevel.

Vertex Bevel.

See also

The Bevel Modifier is a non-destructive alternative to the Bevel tool.

New Edge/Face from Vertices

Reference

Mode:: Edit Mode
Menu:: *Vertex ‣ New Edge/Face from Vertices*
Shortcut:: `F`

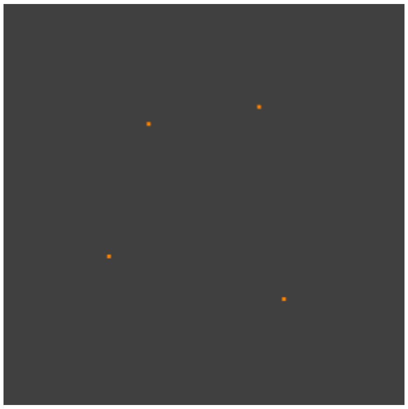
This is a context-sensitive tool which creates geometry by filling in the selection. When only two vertices are selected it will create an edge, otherwise it will create faces.

The typical use case is to select vertices and press `F`, yet Blender also supports creating faces from different selections to help to quickly build up geometry.

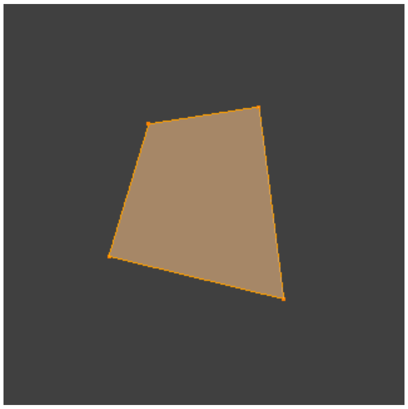
Methods

The following methods are used automatically depending on the context.

Isolated Vertices

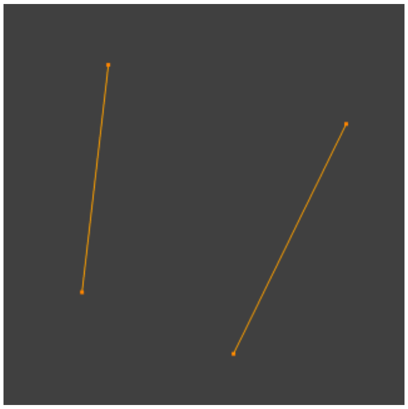


Before.

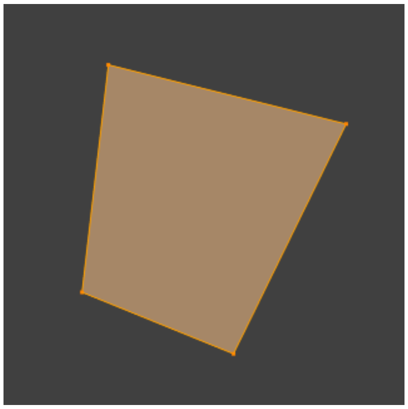


After.

Isolated Edges



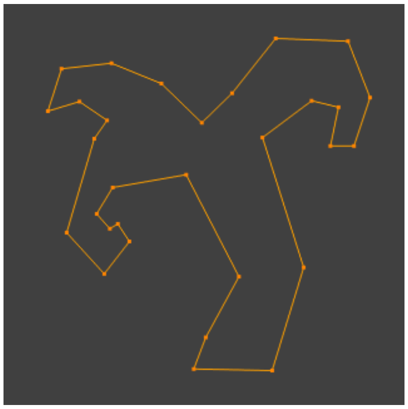
Before.



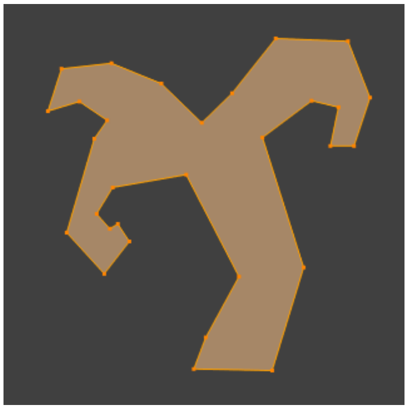
After.

N-gon from Edges

When there are many edges Blender will make an n-gon. Note that, this does not support holes, to support holes you need to use the Fill Faces tool.



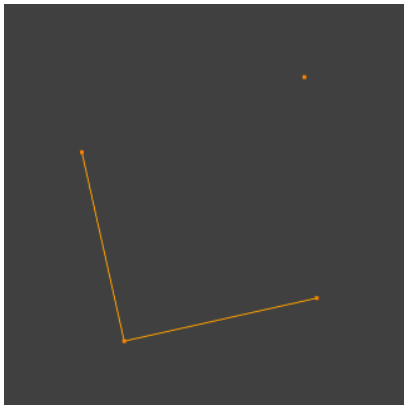
Before.



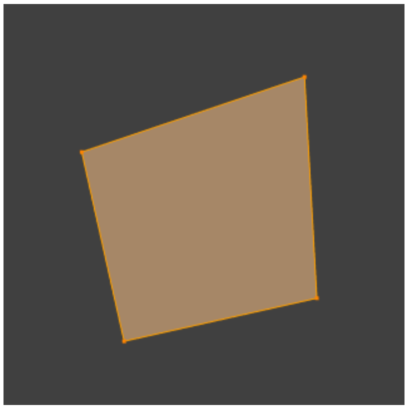
After.

Mixed Vertices/Edges

Existing edges are used to make the face as well as an extra vertex.



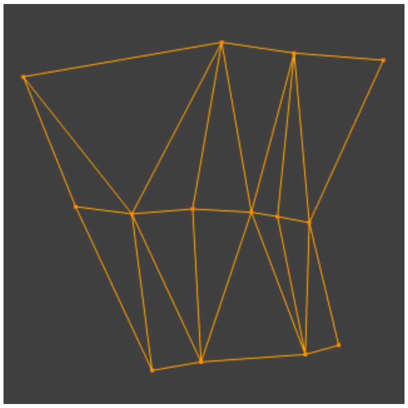
Before.



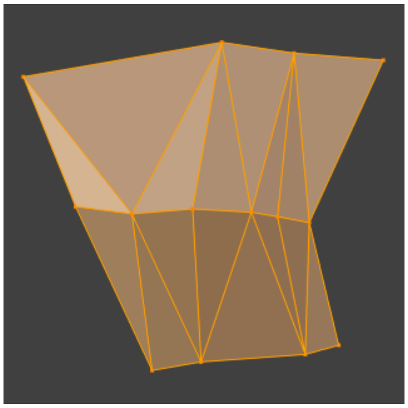
After.

Edge-Net

Sometimes you may have many connected edges without interior faces.



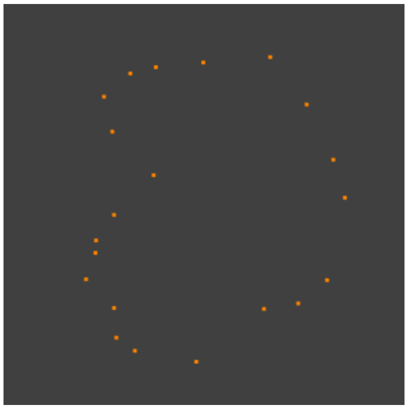
Before.



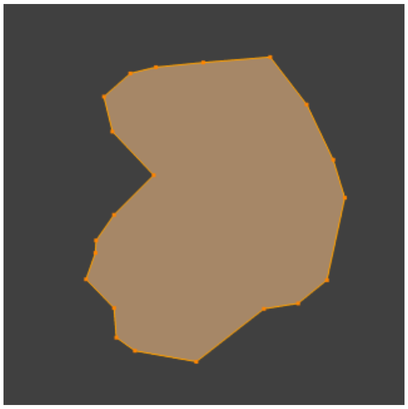
After.

Point Cloud

When there are many isolated vertices, Blender will calculate the edges for an n-gon.



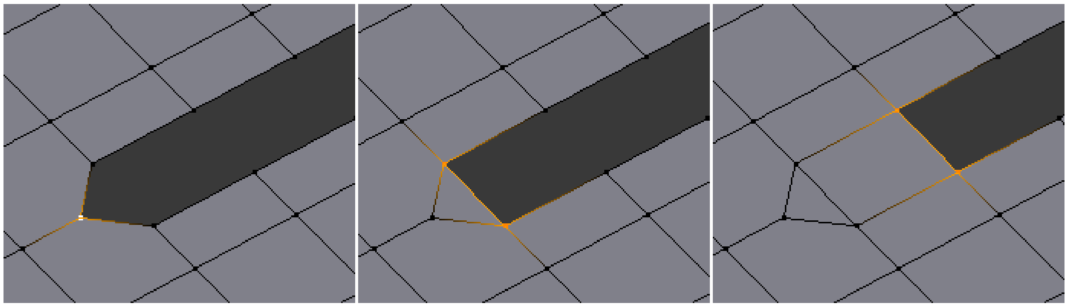
Before.



After.

Single Vertex Selection

With a single vertex selected on a boundary, the face will be created along the boundary, this saves manually selecting the other two vertices. Notice this tool can run multiple times to continue creating faces.



See also

For other ways to create faces see:

- Fill
- Grid Fill
- Bridge Edge Loops

Dissolve Existing Faces

When you have a region of existing faces, creating a face on this selection will remove the shared vertices and edges, creating a single face.

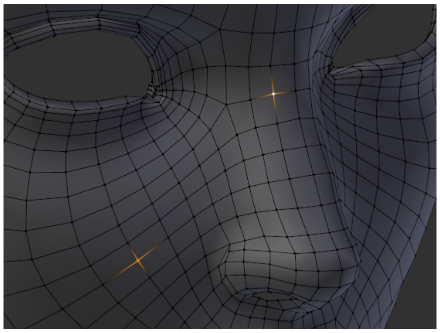
This is simply a convenience for accessing Dissolve Faces.

Connect Vertex Path

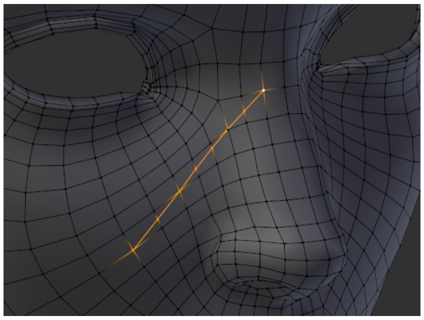
Reference

Mode::	Edit Mode
Menu::	*Vertex ‣ Connect Vertex Path*
Shortcut::	`J`

This tool connects vertices in the order they are selected, splitting the faces between them. When there are only two vertices selected, a cut will be made across unselected faces, a bit like the Knife tool; but this is limited to straight cuts across connected faces.

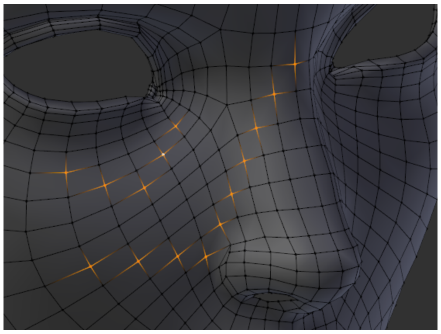


Two disconnected vertices.

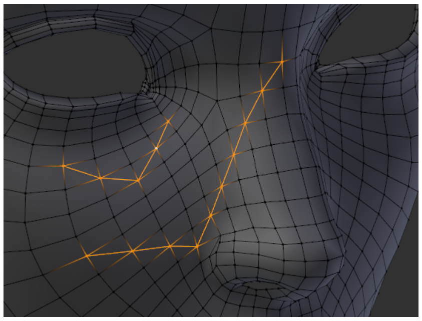


Result of connecting.

Running a second time will connect the first/last endpoints. When many vertices are selected, faces will be split by their selected vertices.



Before.



After.

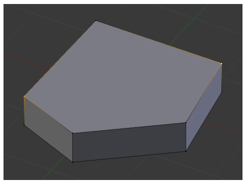
Vertices not connected to any faces will create edges, so this can be used as a way to quickly connect isolated vertices too.

Connect Vertex Pairs

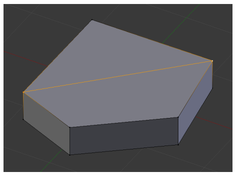
Reference

Mode:: Edit Mode
Menu:: *Vertex ‣ Connect Vertex Pairs*

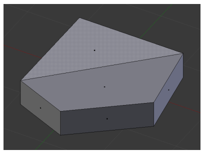
This operator connects selected vertices by creating edges between them and splitting the face. It can be used on many faces at once.



Vertices before connecting.



After connecting vertices.



Resulting face pair.

The main difference between this operator and Connect Vertex Path is that this operator ignores the selection order and connects all selected vertices that share a face.

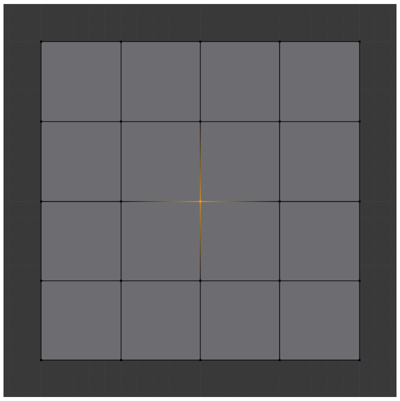
Rip Vertices

Reference

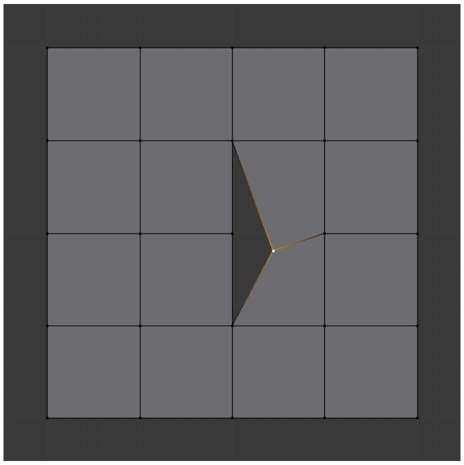
Mode:: Edit Mode
Menu:: *Vertex ‣ Rip Vertices*
Shortcut:: V

Rip creates a "hole" in the mesh by making a copy of selected vertices and edges, still linked to the neighboring non-selected vertices, so that the new edges are borders of the faces on one side, and the old ones, borders of the faces on the other side of the rip.

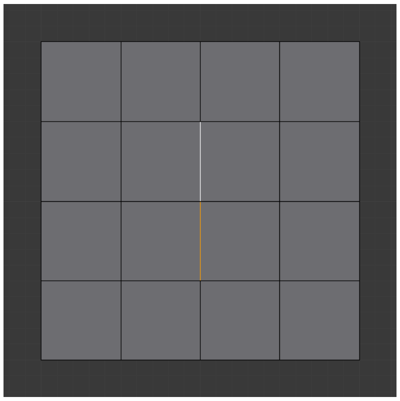
Examples



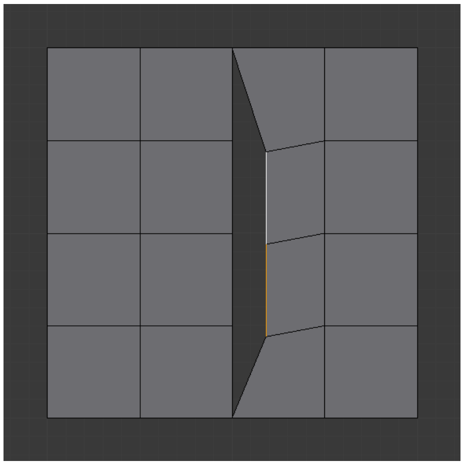
Selected vertex.



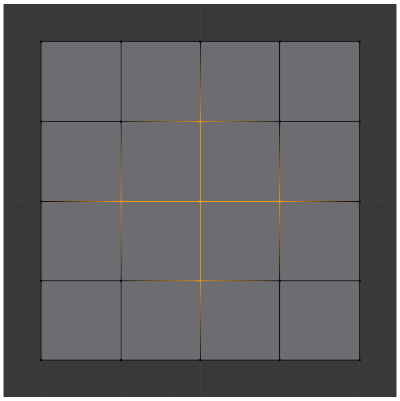
Hole created after using rip on vertex.



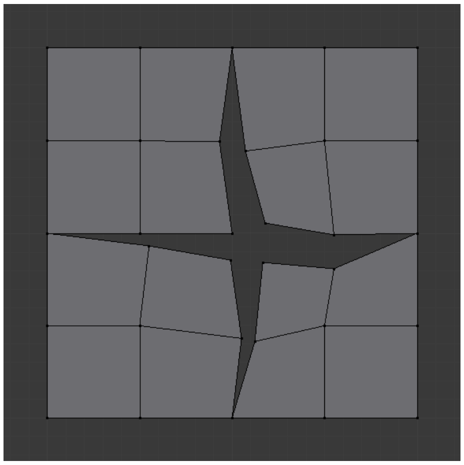
Edges selected.



Result of rip with edge selection.



A complex selection of vertices.



Result of rip operation.

Limitations

Rip will only work when edges and/or vertices are selected. Using the tool when a face is selected (explicitly or implicitly), will return an error message *"Cannot perform ripping with faces selected this way"*. If your selection includes edges or vertices that are not "between" two faces

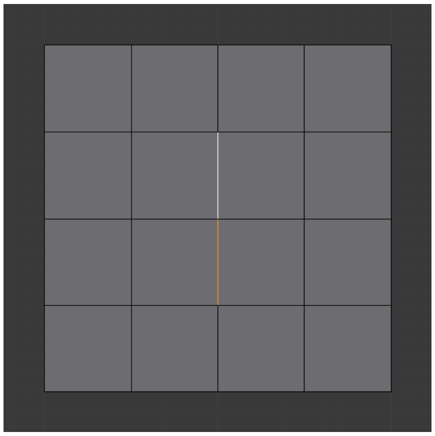
Manifold, it will also fail with the message *“No proper selection or faces include”*.

Rip Vertices and Fill

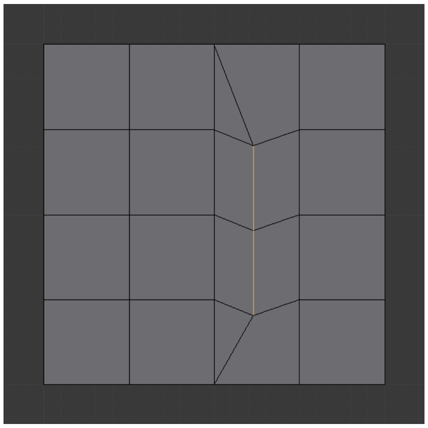
Reference

Mode::	Edit Mode
Menu::	*Vertex ‣ Rip Vertices and Fill*
Shortcut::	`Alt-V`

Rip fill works the same as the Rip tool above, but instead of leaving a hole, it fills in the gap with geometry.



Edges selected.



Result of rip fill.

Rip Vertices and Extend

Reference

Mode::	Edit Mode
Menu::	*Vertex ‣ Rip Vertices and Extend*
Shortcut::	`Alt-D`

This tool takes any number of selected vertices and duplicate-drags them along the closest edge to the mouse. When extending an edge loop, it extends the vertices at the endpoints of the loop. The behavior is similar to the *Extrude* tool, but it creates an n-gon.

It helps to easily add details to existing edges.

Slide Vertices

Reference

Mode::	Edit Mode
Menu::	*Vertex ‣ Slide Vertices*
Shortcut::	`Shift-V`, or `G` twice

Vertex Slide will transform a vertex along one of its adjacent edges. Use `Shift-V` to activate tool. The nearest selected vertex to the mouse cursor will be the control one. Move the mouse along the direction of the desired edge to specify the vertex position. Then press `LMB` to confirm the transformation.

Even `E`

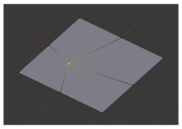
By default, the offset value of the vertices is a percentage of the edges length along which they move. When Even mode is active, the vertices are shifted by an absolute value.

Flipped `F`

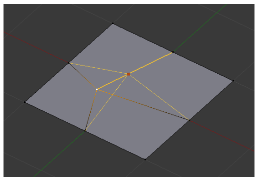
When Flipped is active, vertices move the same distance from adjacent vertices, instead of moving from their original position.

Clamp `Alt` or `C`

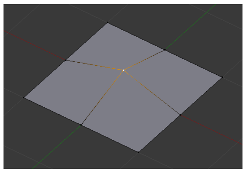
Toggle clamping the slide within the edge extents.



Selected vertex.



Positioning vertex interactively.



Repositioned vertex.

Smooth Vertices

Reference

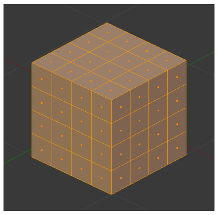
Mode:: Edit Mode
Menu:: *Vertex* ‣ *Smooth Vertices*, *Context Menu* ‣ *Smooth Vertices*

This operator smooths the selected vertices by averaging the angles between the faces.

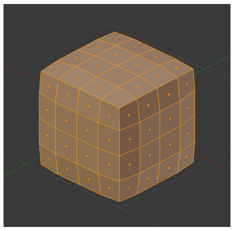
Smoothing
    Smoothing factor.

Repeat
    The number of smoothing iterations.

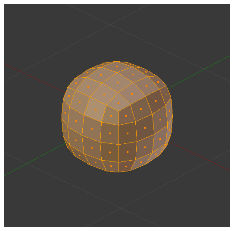
Axes
    Limit the effect to certain axes.



Mesh before smoothing.



Mesh after one smoothing iteration.



Mesh after ten smoothing iterations.

Tip

Using the Smooth tool after subdividing can help create a more organic shape.

See also

Smooth Modifier

The Smooth Modifier, which can be limited to a *Vertex Group*, is a non-destructive alternative to the Smooth operator.

Laplacian Smooth

Reference

Mode::	Edit Mode
Menu::	*Context Menu* ‣ *Laplacian Smooth*

See the Laplacian Smooth Modifier for details.

Laplacian smooth uses an alternative smoothing algorithm that better preserves larger details and this way the overall shape of the mesh. Laplacian smooth exists as a mesh operation and as a non-destructive modifier.

Note

Geometry Smoothing versus Smooth Shading

Do not mistake this tool with the smooth shading options, they do not work the same! This tool modifies the mesh itself, to reduce its sharpness, whereas *Set Smooth* only control the way the mesh is shaded, creating an *illusion* of softness, but without modifying the mesh at all.

Blend from Shape

Reference

Mode:: Edit Mode
Menu:: *Vertex ‣ Blend from Shape*

Blend in the shape from a shape key.

Propagate to Shapes

Reference

Mode::	Edit Mode
Menu::	*Vertex* ▸ *Propagate to Shapes*

Apply selected vertex locations to all other shape keys.

Vertex Groups

Todo.

Hooks

Reference

Mode:: Edit Mode
Menu:: *Vertex ‣ Hooks*
Shortcut:: `Ctrl-H`

Adds a Hook Modifier (using either a new empty, or the current selected object) linked to the selection. Note that even if it appears in the history menu, this action cannot be undone in *Edit Mode* – because it involves other objects…

When the current object has no hooks associated, only the first two options will appear on the menu.

Hook to New Object
: Creates a new Hook Modifier for the active object and assigns it to the selected vertices; it also creates an empty at the center of those vertices, which are hooked to it.

Hook to Selected Object
: Does the same as *Hook to New Object*, but instead of hooking the vertices to a new empty, it hooks them to the selected object (if it exists). There should be only one selected object (besides the mesh being edited).

Hook to Selected Object Bone
: Does the same as *Hook to New Object*, but it sets the last selected bone in the also selected armature as a target.

Assign to Hook
: The selected vertices are assigned to the chosen hook. For that to happen, a list of the hooks associated to the object is displayed. All the

unselected vertices are removed from it (if they were assigned to that particular hook). One vertex can be assigned to more than one hook.

Remove Hook

Removes the chosen hook (from the displayed list) from the object. Which means that the specific Hook Modifier is removed from its modifier stack.

Select Hook

Selects all vertices assigned to the chosen hook (from the hook list).

Reset Hook

It’s equivalent to the *Reset* button of the specific Hook Modifier (chosen from the hook list).

Recenter Hook

It’s equivalent to the *Recenter* button of the specific Hook Modifier (chosen from the hook list).

Make Vertex Parent

Reference

Mode:: Edit Mode
Menu:: *Vertex ‣ Make Vertex Parent*
Shortcut:: `Ctrl-P`

This will parent the other selected object(s) to the vertices/edges/faces selected, as described in parenting.

Edge Operators

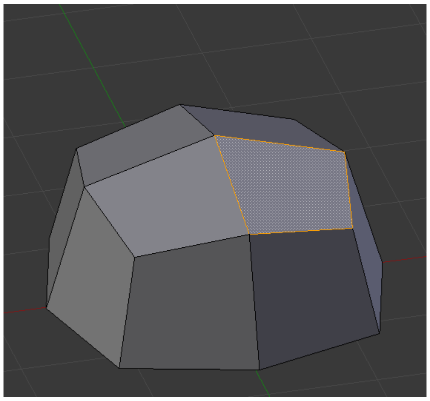
- Extrude Edges
- Bevel Edges
    - Usage
    - Options
    - Examples
- Bridge Edge Loops
    - Examples
- Screw
    - Usage
    - Options
    - Examples
- Subdivide
    - Options
    - Examples
- Subdivide Edge-Ring
- Un-Subdivide
- Rotate Edge
- Edge Slide
    - Usage
- Offset Edge Slide
- Loop Cut and Slide
    - Usage
    - Options
- Edge Data
    - Edge Crease
    - Edge Bevel Weight
    - Mark Seam & Clear Seam
    - Mark Sharp & Clear Sharp
    - Set Sharpness by Angle

Extrude Edges

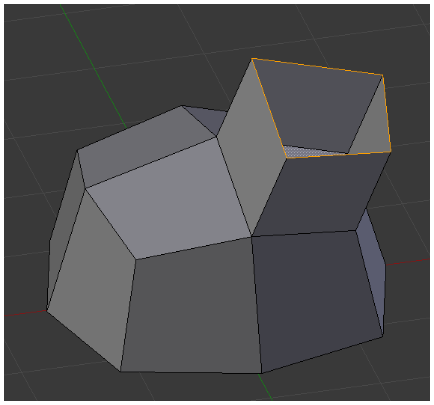
Reference

Mode::	Edit Mode
Menu::	*Edge* ▸ *Extrude Edges Mesh* ▸ *Extrude* ▸ *Extrude Edges*
Shortcut::	`E`

Extrude edges as individual edges.



Edge selected.



Edge extruded.

Bevel Edges

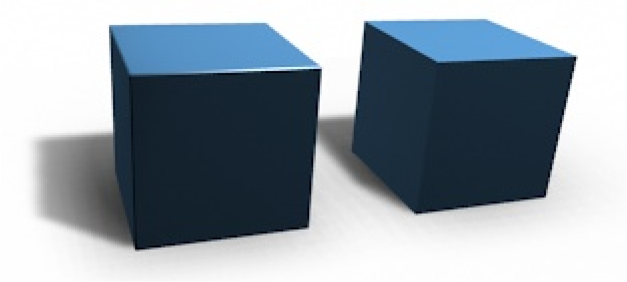
Reference

Mode:: Edit Mode
Menu:: *Edge ‣ Bevel Edges*
Shortcut:: `Ctrl-B` (Bevel Edges)
Menu:: *Vertex ‣ Bevel Vertices*
Shortcut:: `Shift-Ctrl-B` (Bevel Vertices)

The *Bevel* tool allows you to create chamfered or rounded corners on geometry. A bevel is an effect that smooths out edges and corners.

Real world edges are very seldom exactly sharp. Not even a knife blade edge can be considered perfectly sharp. Most edges are intentionally beveled for mechanical and practical reasons.

Bevels are also useful for giving realism to non-organic models. In the real world, the blunt edges on objects catch the light and change the shading around the edges. This gives a solid, realistic look, as opposed to un-beveled objects which can look too perfect.

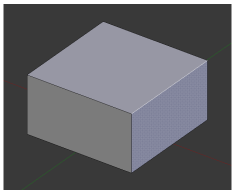


Cubes with and without bevel.

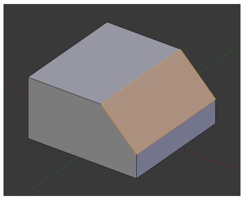
Usage

The *Bevel Edges* tool works only on selected edges with exactly two adjacent faces. It will recognize any edges included in a vertex or face selection as well, and perform the bevel the same as if those edges were explicitly selected. In "vertex only" mode, the *Bevel Vertices* tool works on selected vertices instead of edges, and there is no requirement about having any adjacent faces. The *Bevel* tool smooths the edges and/or "corners" (vertices) by replacing them with faces making smooth profiles with a specified number of *segments* (see the options below for details about the bevel algorithm).

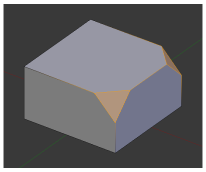
Use `Ctrl-B` or a method listed above to run the tool. Move the mouse to interactively or type a number to specify the bevel offset, and scroll the `Wheel` to increase or decrease the number of segments (see below).



Selected edge before beveling.



Result of bevel (one segment).



Result of bevel (vertex only).

Note

Normal (edge) beveling only works on edges that have exactly two faces attached to them. Vertex beveling has no such restriction.

Options

Affect `V`

Vertices

Only the areas near vertices are beveled, the edges remain unchanged.

Edges

Bevel the edges, creating intersections at vertices.

Width Type `M`

Selects how the *Width* value controls the size of the bevel. According to the selection, the width is:

Offset::	The distance from the new edge to the original.
Width::	The distance between the two new edges formed by the bevel (or the edges on either side of the bevel if there is more than one segment).
Percent::	The percentage of the length of adjacent edges that the new edges slide.
Absolute::	The exact distance along edges adjacent to the beveled edge. A difference from **Offset** is visible when the unbeveled edges attached to beveled edges meet at an angle besides a right angle.

For vertex-only bevels, the Offset and Depth types measure from the original vertex. The Width type is measured from a new vertex to the center of the new face (as half the *Width*).

Width `A`

You can change the bevel width by moving the mouse towards and away from the object, a bit like with transform tools. The exact meaning of the value depends on the *Width Type* option (see above). As usual, the scaling can be controlled to a finer degree by holding `Shift` to scale in 0.001 steps. `LMB` finalizes the operation, `RMB` or `Esc` aborts the action.

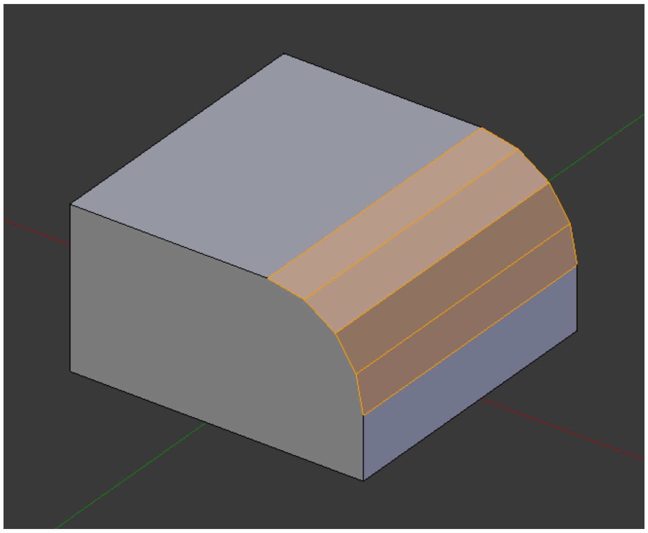
Note

When multiple edges are beveled at the same time, it is sometimes impossible to make the width match the above definition on all edges simultaneously. Bevel tries to compromise in such cases. Sometimes turning off Loop Slide (see below) can make it easier for Bevel to make the widths as specified.

Segments `S`

The number of segments in the bevel can be defined by scrolling the mouse `Wheel` to increase or decrease this value. The greater the number of segments, the smoother the bevel. Or press `S` to change the number with mouse movements, as well as numeric input.

Alternatively, you can manually enter a segment number value while using the tool, or in the Mesh Tool options panel after using the tool.



Bevel with four segments.

Shape `P`

This is a number between 0 and 1 that controls the shape of the profile (side view of a beveled edge). The default value, 0.5, gives a circular arc (if the faces meet at right angles). Values less than that give a flatter profile, with 0.25 being exactly flat, and values less than that giving a concave bevel. Values more than 0.5 give a more convex profile. Similarly as *Segments* it can be set with mouse movements and numeric input after toggling `P`.

Material Index

The *Material* number specifies which material is assigned to the new faces created by the *Bevel* tool. With the default, -1, the material is inherited from the closest existing face ("closest" can be a bit ambiguous). Otherwise, the number is the slot index of the material to use for all newly created faces.

Harden Normals `H`

When enabled, the per-vertex face normals of the bevel faces are adjusted to match the surrounding faces, and the normals of the surrounding faces are not affected. This will keep the surrounding faces flat (if they were before), with the bevel faces shading smoothly into them. For this effect to work, a mesh must have custom split normals. As a convenience, that option will be enabled for you if it is not already when you enable Harden Normals here.

Clamp Overlap `C`

Limits the width of each beveled edge so that edges cannot cause overlapping intersections with other geometry.

Loop Slide

If there are un-beveled edges along with beveled edges into a vertex, the bevel tries to slide along those edges when possible. Turning the option off can lead to more even bevel widths.

Mark

Seams `U`

If a seam edge crosses a non-seam one and you bevel all of them, this option will maintain the expected propagation of seams.

Sharp `K`

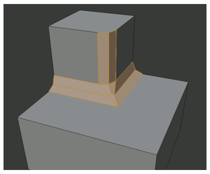
Similar to Mark Seams, but for sharp edges.

Miter Outer `O`

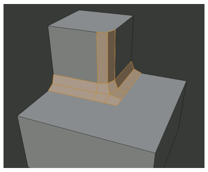
A *miter* is formed when two beveled edges meet at an angle. On the side where the angle is greater than 180 degrees, if any, it is called an *outer miter*. This option specifies the pattern that Blender uses at an outer miter.

Sharp::	Edges meet at a sharp point, with no extra vertices introduced on the edges.
Patch::	Edges meet at a sharp point but in addition, two extra vertices are introduced near the point so that the edges and faces at the vertex may be less pinched together than what occurs in the *Sharp* case.
Arc::	Two vertices are introduced near the intersection, and a curved arc joins them together. The *Spread* slider controls how far the new vertices are from the intersection. The *Profile* curve widget controls the shape of the arc.

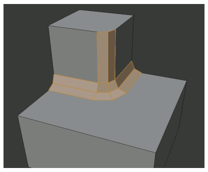
The current choices are shown in this diagram, where the outer miter is along the horizontal surface.



Sharp outer miter.



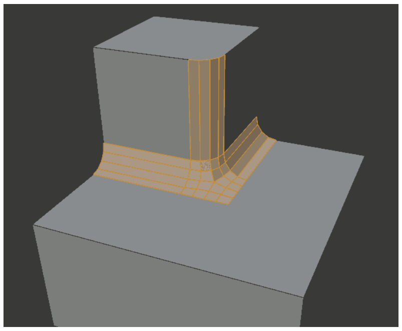
Patch outer miter.



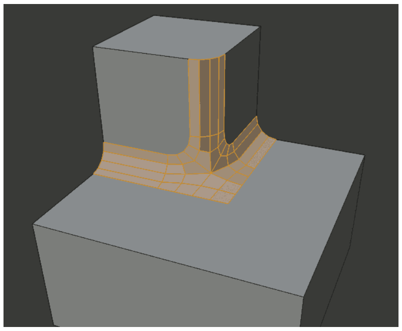
Arc outer miter.

Inner `I`

An *Inner Miter* is formed when the angle between two beveled edges is less than 180 degrees. This option specifies the pattern Blender uses at an inner miter. The options are the same as for Outer Miter, except that *Patch* makes no sense and is therefore omitted. Inner miters are shown in the following diagram, where two inner miters are on the vertical surfaces.



Sharp inner miter.



Arc inner miter.

Spread

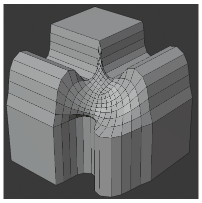
The value used to spread extra vertices apart for *Outer* and *Inner Miters*. This option is available when Miter Inner is set to Arc.

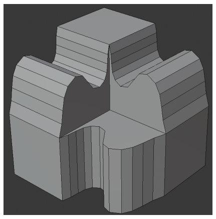
Intersection Type N

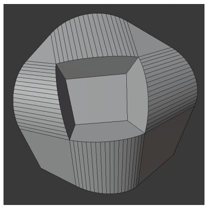
When more than two beveled edges meet at a vertex, a mesh is created as a way to complete the intersection between the generated geometry. This option controls the method used to create that mesh.

Grid Fill::	The default method for building intersections, useful when a smooth continuation of the bevel profile is desired. Without *Custom Profile* enabled, the curve of the profile continues through the intersection, but with a custom profile it just creates a smooth grid within the intersection's boundary.
Cutoff::	Creates a cutoff face at the end of each beveled edge coming into the vertex. This is most useful for custom profiles when the new intersection is too complex for a smooth grid fill. With a three way intersection, when the inner corners of the cutoff profiles faces meet at the same location, no center face is created. The direction of the cutoff faces depends on the original vertex's normal.

Intersection method options.


Grid fill intersection method.


Three way cutoff intersection where the inner vertices are merged.


Cutoff intersection method with a center face.

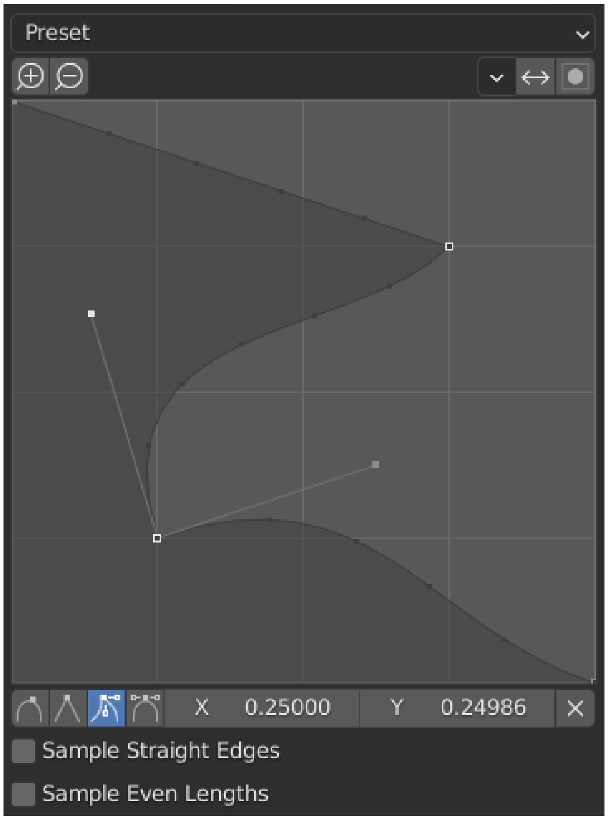
Face Strength

Set *Face Strength* on the faces involved in the bevel, according to the specified mode. This can be used in conjunction with a Weight Normals Modifier (with the *Face Influence* option checked).

None::	Do not set face strength.
New::	Set the face strength of new faces along edges to *Medium*, and the face strength of new faces at vertices to *Weak*.
Affected::	In addition to those set for the *New* case, also set the faces adjacent to new faces to have strength *Strong*.
All::	In addition to those set for the *Affected* option, also set all the rest of the faces of the model to have strength *Strong*.

Profile Type `Z`

Superellipse::	Creates a bevel with a uniform concave or convex curve.
Custom::	This Curve Widget allows the creation of a user-defined profile with more complexity than with the single profile parameter. The modal tool



The custom profile widget.

allows toggling the custom profile, but the shape of the profile is only editable in the options panel after the operation is confirmed.

The profile starts at the bottom right of the widget and ends at the top left, as if it were between two edges intersecting at a right angle. Control points are created in the widget and then the path is sampled with the number of segments from the Bevel modifier.

Note

The *Profile* curve widget stays active when miters are enabled because it still controls the shape of the miter profiles.

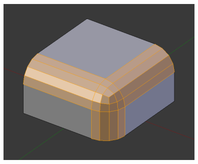
Presets

The *Support Loops* and *Steps* presets are built dynamically depending on the number of segments in the bevel. If the number of segments is changed, the preset will have to be re-applied.

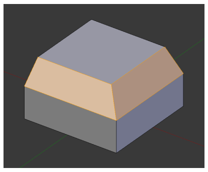
Sampling

Samples will first be added to each control point, then if there are enough samples, they will be divided evenly between the edges. The *Sample Straight Edges* option toggles whether the samples are added to edges with sharp control points on either side. If there aren't enough samples to give each edge the same number of samples, they will just be added to the most curved edges. So it is recommended to use at least as many segments as there are control points.

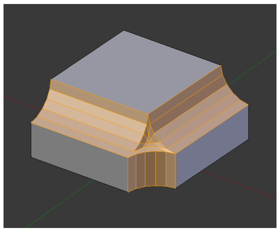
Examples



Result of beveling multiple edges.



Another example of beveling multiple edges.



An example using Profile=0.150.

See also

The Bevel Modifier is a non-destructive alternative to the Bevel tool.

Bridge Edge Loops

Reference

Mode:: Edit Mode
Menu:: *Edge ▸ Bridge Edge Loops*

Bridge Edge Loops connects multiple edge loops with faces.

Connect Loops
- **Open Loop::** Loops connected with open ends.
- **Closed Loop::** Tries to connect to a circular loop (where the start and end are merged).
- **Loop Pairs::** Connects each even count of loops individually.

Merge

Merges edge loops rather than creating a new face.

Merge Factor

Which edge loop the edges are merged to, a value of 0.5 will merge at a half-way point.

Twist

Determines which vertices in both loops are connected to each other.

Number of Cuts

The number of intermediate edge loops used to bridge the distance between two loops.

Interpolation

Linear, Blend Path, Blend Surface

Smoothness

Smoothness of the *Blend Path* and *Blend Surface*.

Profile Factor

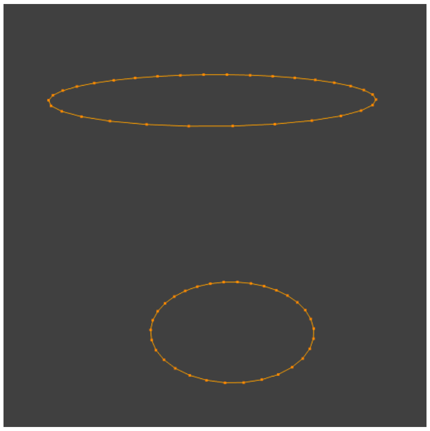
How much intermediary new edges are shrunk/expanded.

Profile Shape

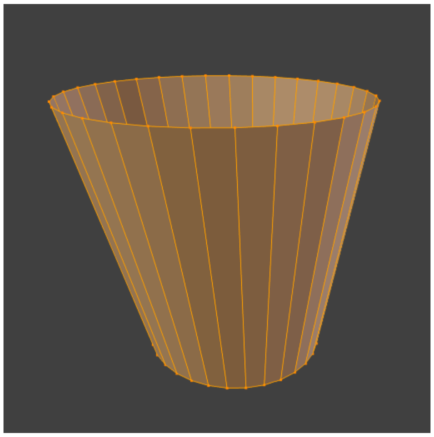
The shape of the new edges. See the Proportional Editing page for a description of each option.

Examples

Simple example showing two closed edge loops.

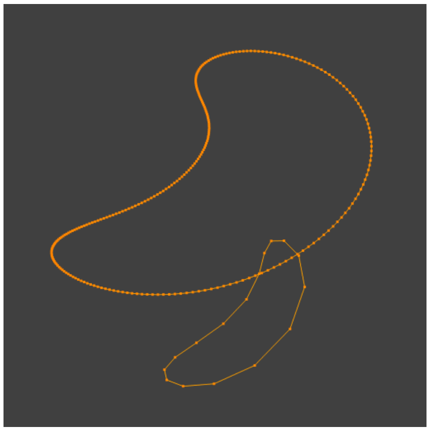


Input.

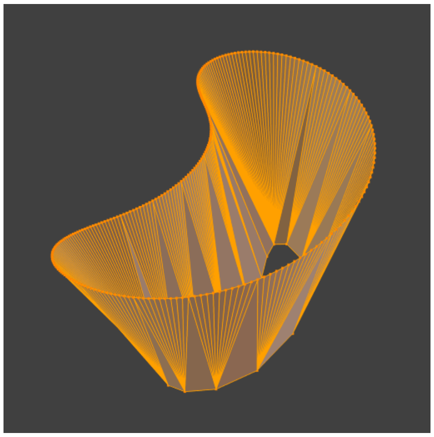


Bridge result.

Example of the Bridge tool between edge loops with different numbers of vertices.

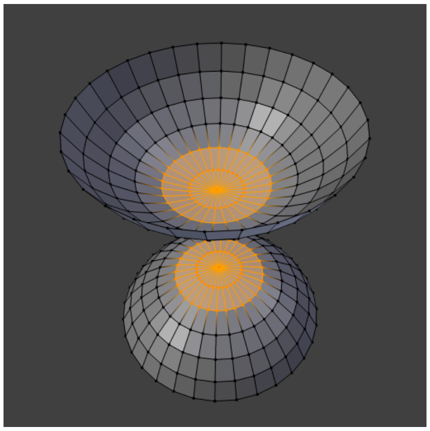


Input.

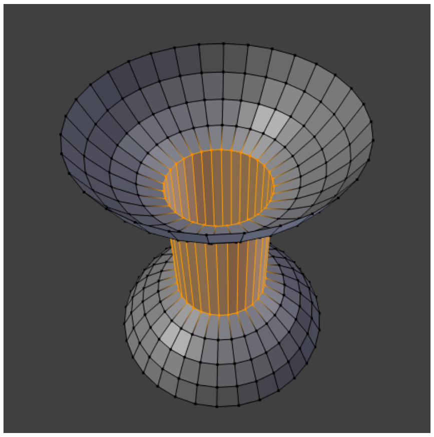


Bridge result.

Example using the Bridge tool to cut holes in face selections and connect them.

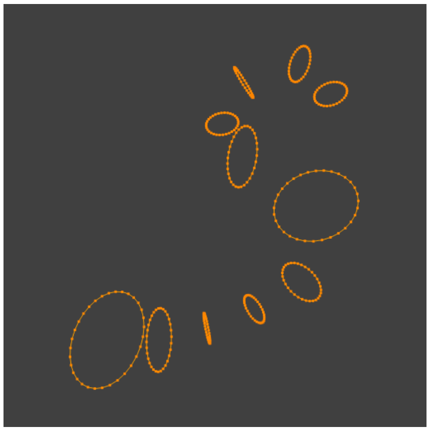


Input.

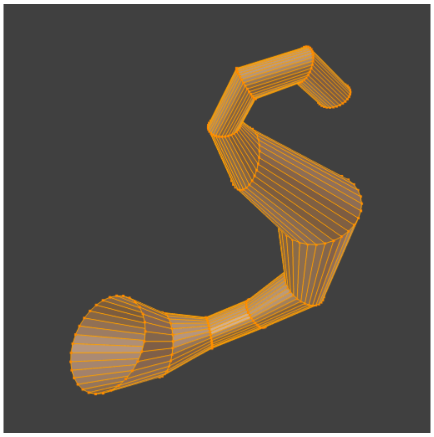


Bridge result.

Example showing how Bridge tool can detect multiple loops and connect them in one step.

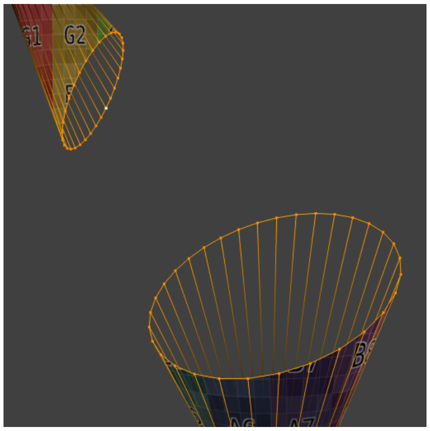


Input.

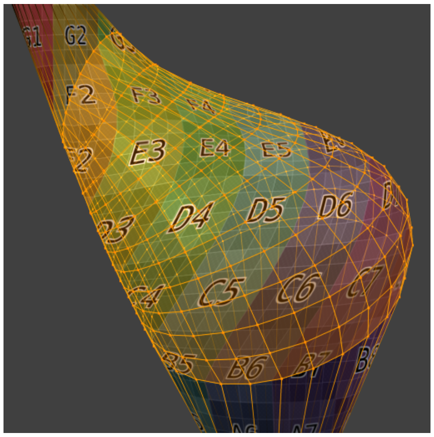


Bridge result.

Example of the subdivision option and surface blending with UVs.



Input.


G1
G2
F2
F3
F4
E3
E4
E5
D3
D4
D5
D6
C4
C5
C6
C7
B5
B6
B7

Bridge result.

Screw

Reference

Mode::	Edit Mode
Menu::	*Edge* ▸ *Screw*

The *Screw* operator extrudes geometry along a helix. You can use it to create screws, springs, sea shells and so on.

While it's similar to the Screw Modifier, there are some important differences:

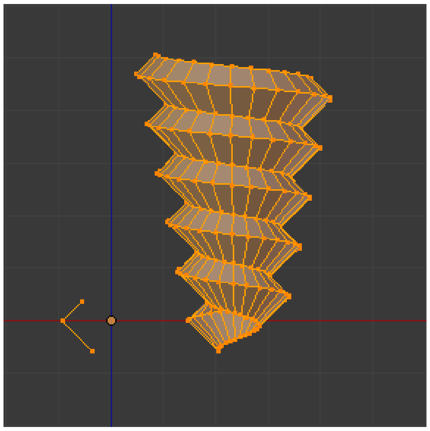
Screw operator	Screw modifier
Works in world space.	Works in object space.
Extrudes only the selected geometry.	Extrudes all geometry.
The centerpoint can be specified manually.	The centerpoint is always the object's origin.
One revolution is always 360°.	The angle can be chosen freely.
The height offset of each revolution is calculated automatically based on the geometry.	The height offset must be specified manually.

Screw operator	Screw modifier
Each revolution can also have a radial offset away from/towards the central axis (again determined by the geometry).	The radius stays constant.

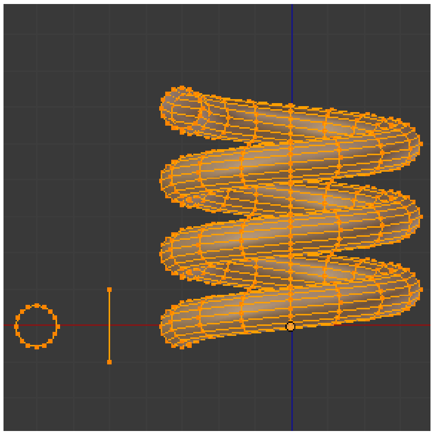
As described above, the Screw operator automatically determines the height offset and radial offset to apply after each revolution. It does this by looking for the endpoints of an open profile – a series of connected edges that don't form a closed loop. The geometry is extruded so that the profile's top vertex in one revolution will coincide with the bottom vertex in the next.

The most common use case is extruding such an open profile. You're not limited to this, however. As long as there is one open profile in the selection – even just a single loose edge – you can also extrude closed profiles and even geometry with faces.

You can see some examples below.



Wood Screw.



Spring.

Usage

First, make sure you have an open profile in your mesh. If you want to extrude anything else (such as one or more circles), you should create an open profile next to it.

Once that's done, enter *Edit Mode* and select the geometry you want to extrude, making sure to include exactly one open profile. If you have fewer or more, the operator will fail with the error "You have to select a string of connected vertices too."

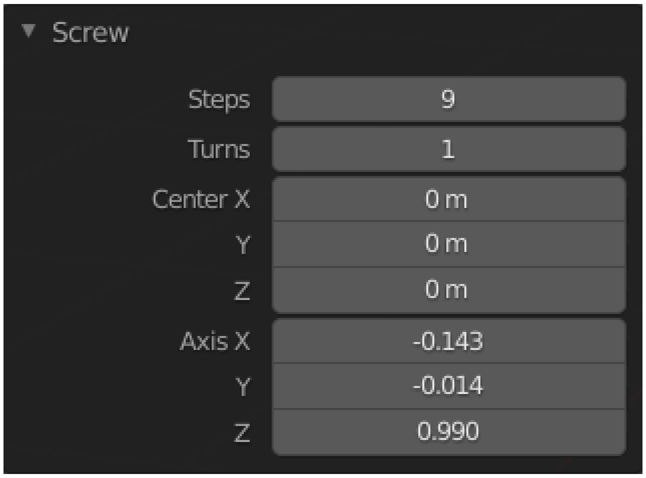
Make sure the 3D Cursor is at the centerpoint around which you want the geometry to turn. Also make sure that the vertical axis on your screen matches the direction of the axis around which it should turn. The most common example is turning around the global Z axis: for that, you'd place the 3D Cursor at the world origin and switch to an orthographic side view.

Now you're ready to run the operator: open the *Edge* menu (by clicking it in the 3D Viewport's header or pressing `Ctrl-E`) and click *Screw*.

You can change the number of steps and turns in the Adjust Last Operation panel.

If you only created an open profile to guide the extrusion (not because you wanted its geometry), you can select its extruded faces by hovering over one and pressing `L`, then delete them by pressing `X` or `Delete`.

Options



Screw

Steps 9

Turns 1

Center X 0 m

Y 0 m

Z 0 m

Axis X -0.143

Y -0.014

Z 0.990

Screw panel (in Edit Mode).

Steps
The number of extrusions to be done for each 360° turn.

Turns
The number of turns to create.

Center X, Y, Z
The worldspace coordinates of the centerpoint around which to spin the geometry. Initially this is the location of the 3D Cursor.

Axis X, Y, Z
The direction vector around which to spin the geometry. Initially this is the screen-space vertical axis (so the global Z axis when in a side view or the global Y axis when in top view). By inverting the *Axis*, you can flip between going clockwise and counterclockwise.

Tip

You can use the Align View to Active menu item to align the viewport, and thereby the *Axis*, to a certain item in the scene.

Notice that the *Axis* only determines how the geometry spins “horizontally” around the centerpoint. It doesn’t determine how the geometry moves “vertically.” Instead, the geometry always moves by a distance and direction given by the endpoints of the open profile, and goes downward in the object’s local space.

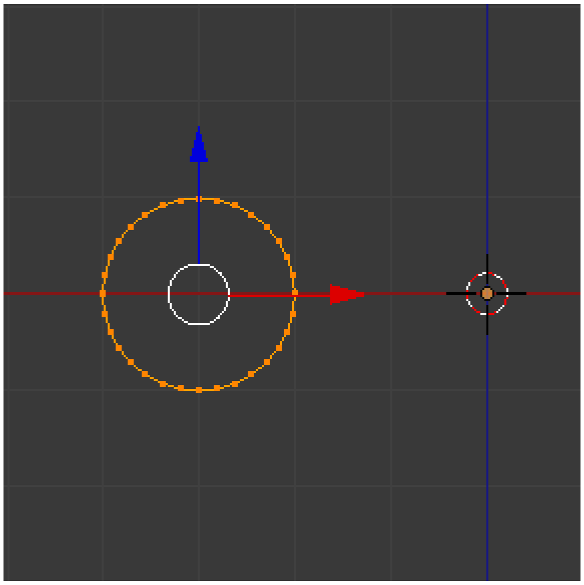
Examples

Creating a Spring

First, let’s create a circle to serve as the spring’s cross section:

1. Open Blender and delete the default Cube.

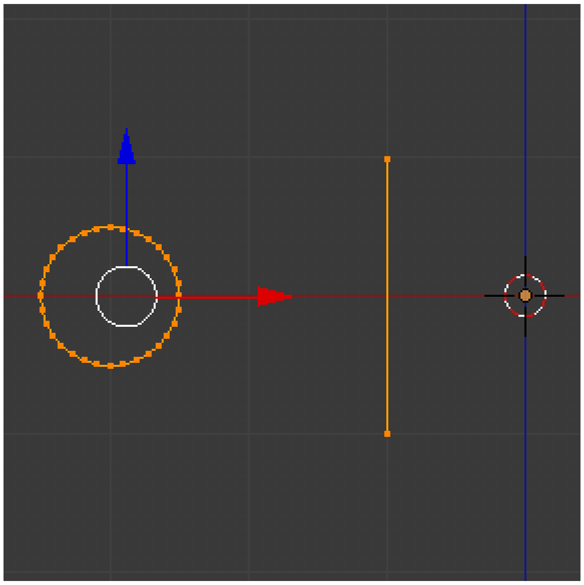
2. Add a circle by pressing `Shift-A` and selecting *Mesh* ▸ *Circle*.
3. Set the *Location X* property of this new object to -3 and its *Rotation X* property to 90°.
4. Enter *Edit Mode* by pressing `Tab`.
5. Switch to the *Front Orthographic* view by pressing `Numpad1`.



Extrusion profile created.

Next, let's create a vertical line to specify the distance between spring loops:

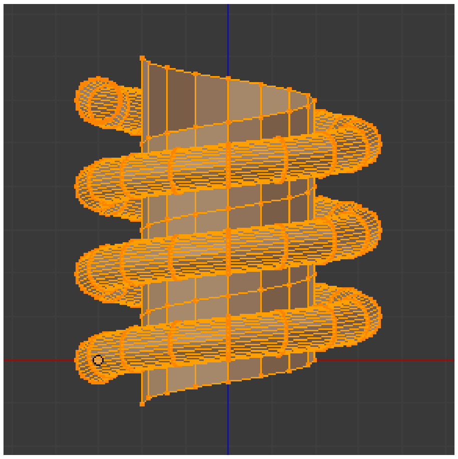
1. Deselect all vertices by clicking on an empty space or pressing `Alt-A`.
2. Click `Ctrl-RMB` twice to create two vertices connected by an edge.
3. Select both vertices and press `S X 0 Return` to ensure they have the same X coordinate. (This is necessary to keep the spring's radius constant.)



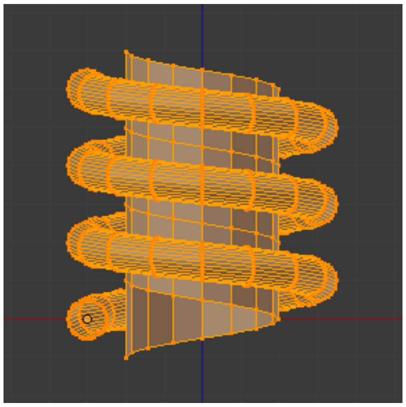
Guide profile created.

Now, we're ready to create the spring:

1. Select both the circle and the line by pressing `A`.
2. Click *Edge* ▸ *Screw*.
3. Adjust the *Steps* and *Turns* to your liking.
4. Try changing *Axis Z* to -1 and see that this makes the spring turn the other way.

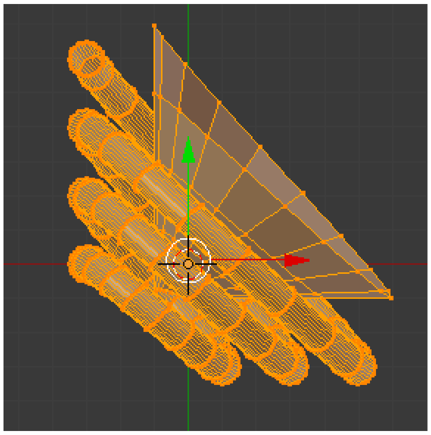


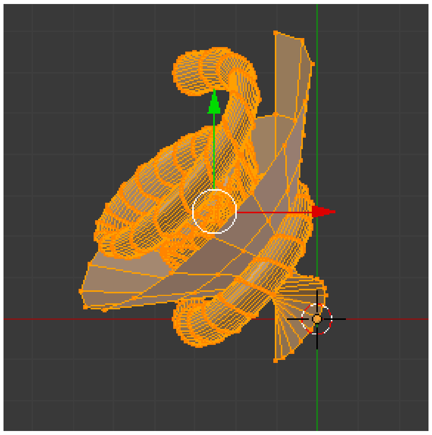
Counterclockwise direction.



Flipped to Clockwise direction.

You can get some interesting results by making the *Axis* diagonal (e.g. keeping *Axis Z* at -1 and setting *Axis X* to 1). Notice that each individual spring loop is inclined by 45°, but that after each loop, we still go down vertically (in the direction of the guide line).

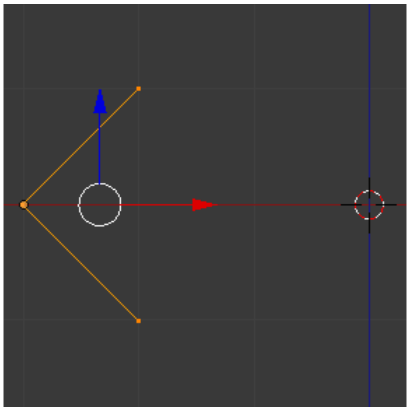




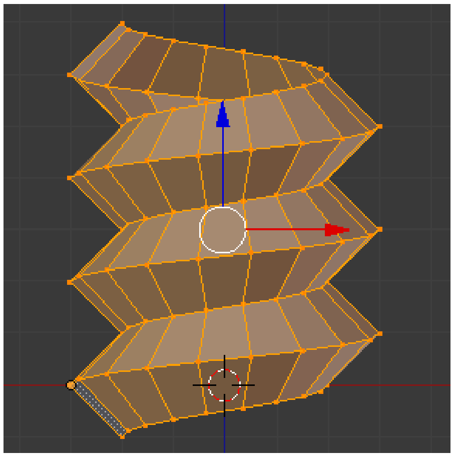
Creating a Screw Spindle

The Screw operator is perfectly suited for creating helixes without any gaps between the turns.

1. Open Blender and enter *Edit Mode* for the default cube.
2. Delete all vertices by pressing `X` or `Delete`.
3. Switch to the *Front Orthographic* view by pressing `Numpad1`.
4. Click `Ctrl–RMB` three times to create a profile like the one below.
5. Select the two vertices closest to the global Z axis and press `S X 0 Return` to ensure they have the same X coordinate.
6. Select all three vertices and click *Edge* ▸ *Screw*.
7. Adjust the *Steps* and *Turns* to your liking.



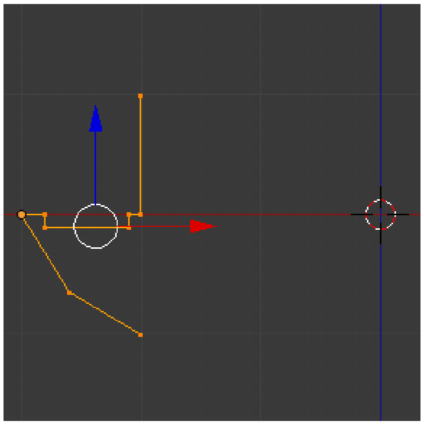
Profile for a screw spindle.



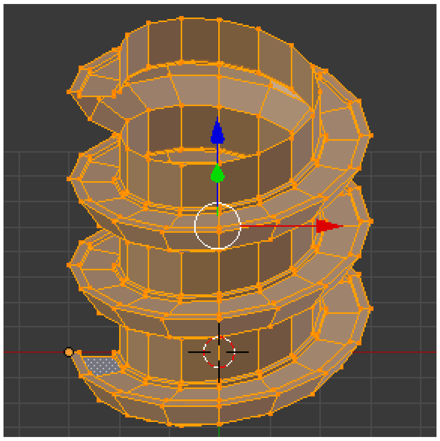
Result after running the Screw operator.

You can also create more interesting shapes, like this spiral “staircase”:

Ramp.



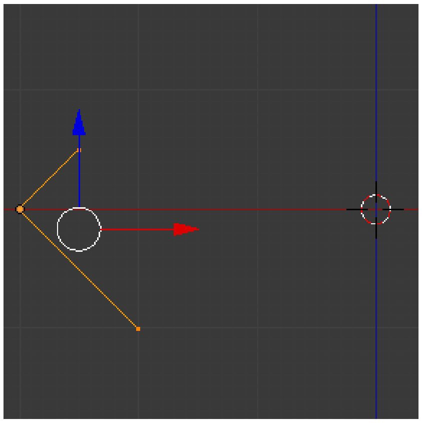
Profile.



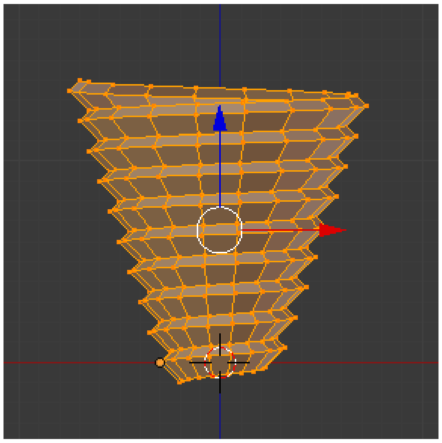
Generated mesh.

Creating a Screw Tip

Until now, we’ve always made sure that the first and last vertex of the profile have the same X coordinate, thereby keeping the radius of the helix constant. However, nothing stops you from using different X coordinates and having the helix shrink/expand along its height.



Profile.



Generated.

Subdivide

Reference

Mode:: Edit Mode
Menu:: *Edge ‣ Subdivide*

Subdividing splits selected edges and faces by cutting them in half or more, adding new vertices, and subdividing accordingly the faces involved. It adds resolution to the mesh by divide faces or edges into smaller units.

This process follows a few rules, depending on the settings:

- When only one edge of a face is selected (Triangle mode), triangles are subdivided into two triangles, and quads, into three triangles.
- When two edges of a face are selected:
    - If the face is a triangle, a new edge is created between the two new vertices, subdividing the triangle in a triangle and a quad.
    - If the face is a quad, and the edges are neighbors, there have *three* possible behaviors to divide the quad, depending on the setting of *Quad Corner Type* (see below for details).
    - If the face is a quad, and the edges are opposite, the quad is just subdivided in two quads by the edge linking the two new vertices.
- When three edges of a face are selected:
    - If the face is a triangle, this means the whole face is selected and it is then subdivided in four smaller triangles.
    - If the face is a quad, first the two opposite edges are subdivided as described above. Then, the “middle” edge is subdivided, affecting its new “sub-quad” as described above for only one edge.
- When a face of a Quad is selected, the face is subdivided into four smaller quads.
- When a face of an N-gon is selected, the individual edges will be subdivided but the face will stay unsubdivided.

Options

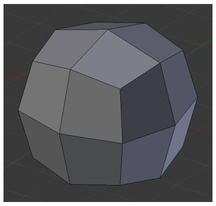
These options are available in the *Tool* panel after running the tool:

Number of Cuts

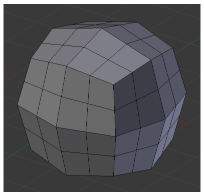
Specifies the number of cuts per edge to make. By default this is 1, cutting edges in half. A value of 2 will cut it into thirds, and so on.

Smoothness

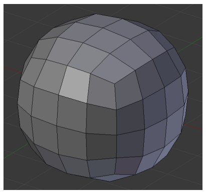
Displaces subdivisions to maintain approximate curvature. The effect is similar to the way the Subdivision Surface Modifier might deform the mesh.



Mesh before subdividing.



Subdivided with no smoothing.



Subdivided with smoothing of 1.

Quad/Tri Mode

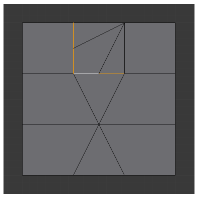
Forces subdivide to create triangles or quads instead of n-gons (see examples below). This mode doesn't allow the use of *Straight Cut* on quad corners.

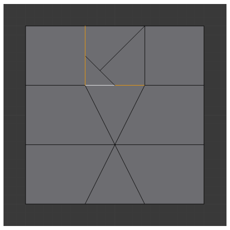
Quad Corner Type

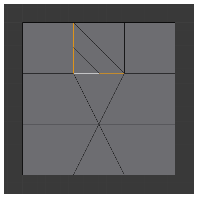
Controls the way quads with only two adjacent selected edges are subdivided.

Fan::	The quad is subdivided in a fan of four triangles, the common vertex being the one opposite to the selected edges.
Inner Vertices::	

	The selected edges are subdivided, then an edge is created between the two new vertices, creating a small triangle. This edge is also subdivided, and the “inner vertex” thus created is linked by another edge to the one opposite to the original selected edges. All this results in a quad subdivided in a triangle and two quads.
Path::	First an edge is created between the two opposite ends of the selected edges, dividing the quad in two triangles. Then, the same goes for the involved triangle as described above.
Straight Cut::	The selected edges are subdivided, then an edge is created between the two new vertices, creating a small triangle and n-gon.

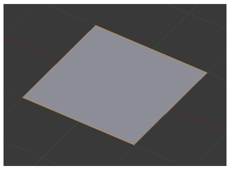

Fan cut type.

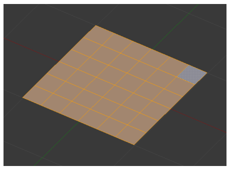

Inner Vertices cut type.

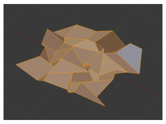

Path cut type.

Fractal

Displaces the vertices in random directions after the mesh is subdivided.

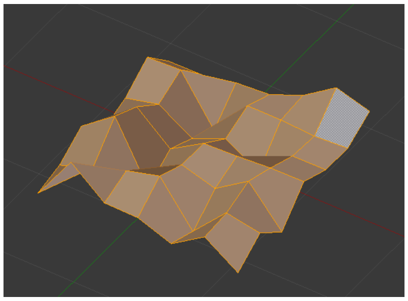

Plane before subdivision.


Regular subdivision.


Same mesh with fractal added.

Along Normal

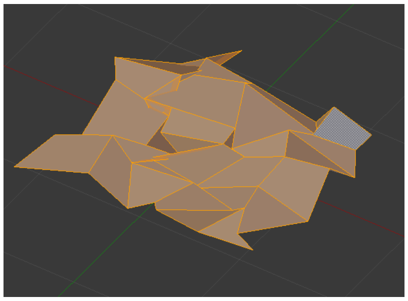
Causes the vertices to move along their normals, instead of random directions.



Along normal set to 1.

Random Seed

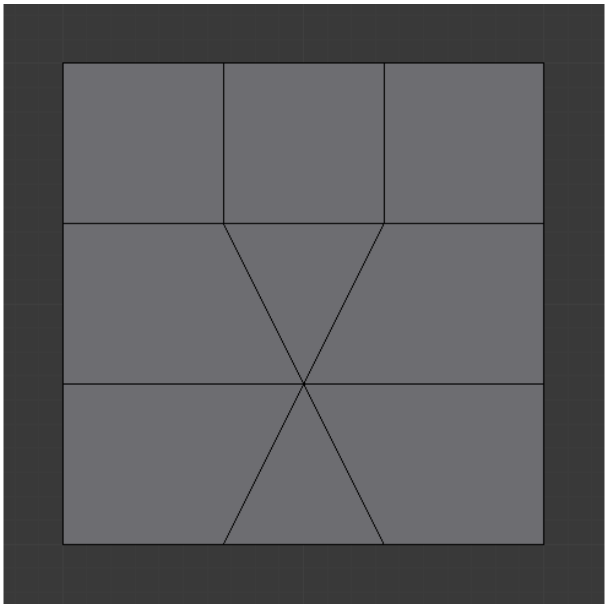
Changes the random seed of the *Fractal* noise function, producing a different result for each seed value.



Same mesh with a different seed value.

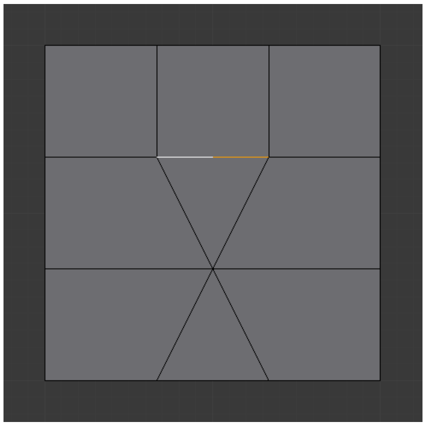
Examples

Below are several examples illustrating the various possibilities of the *Subdivide* and *Subdivide Multi* tools. Note the selection after subdivision.

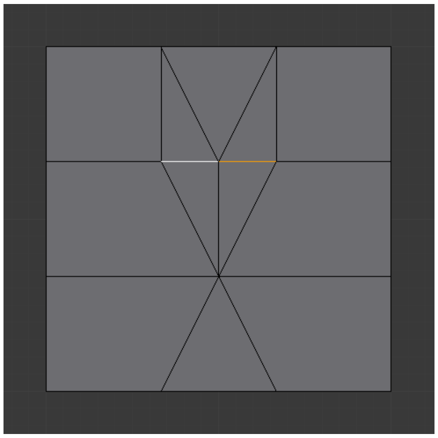


The sample mesh.

One Edge

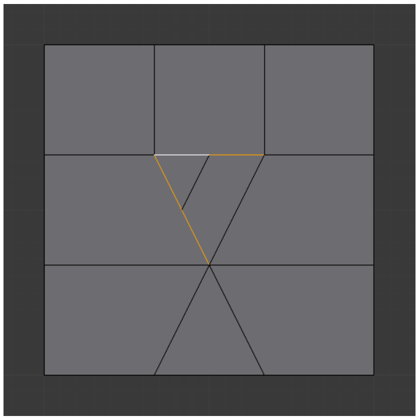


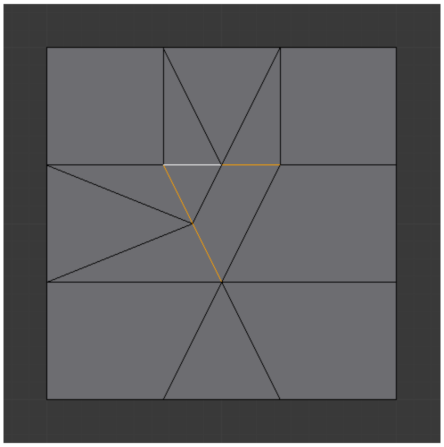
One Edge.



Quad/Tri Mode.

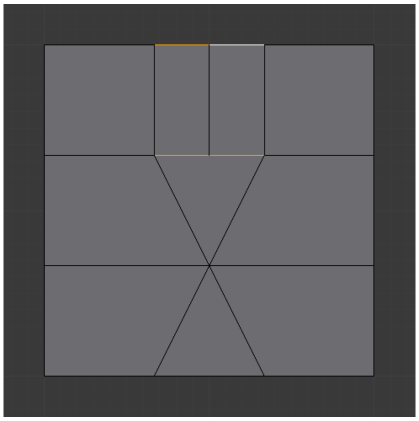
Two Tri Edges

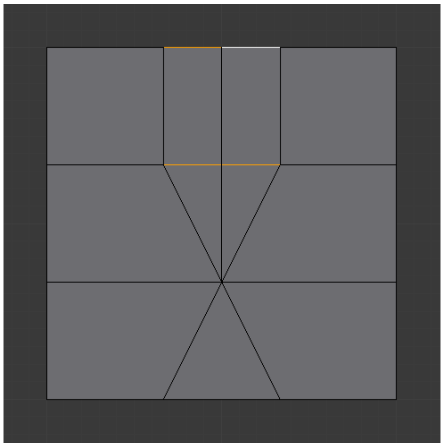




Quad/Tri Mode.

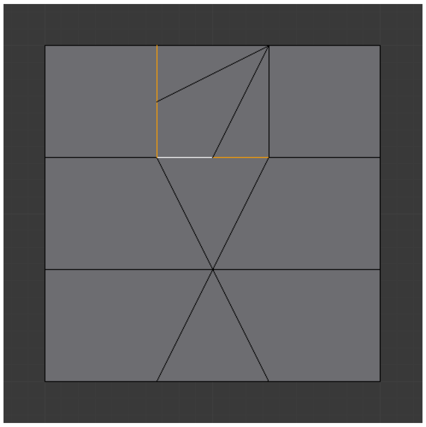
Two Opposite Quad Edges



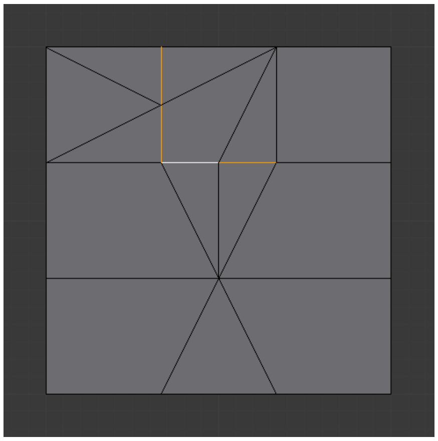


Quad/Tri Mode.

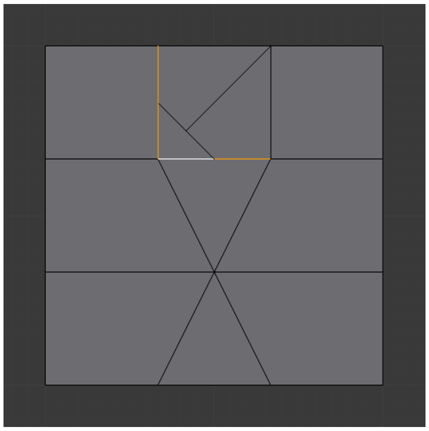
Two Adjacent Quad Edges



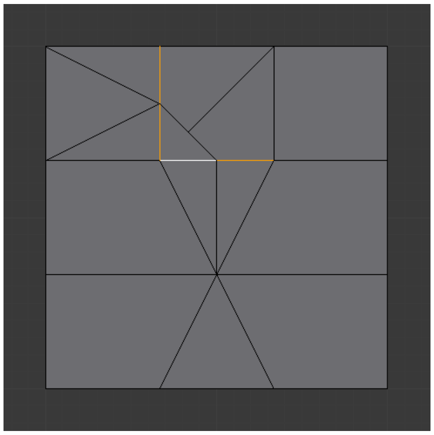
Fan cut type.



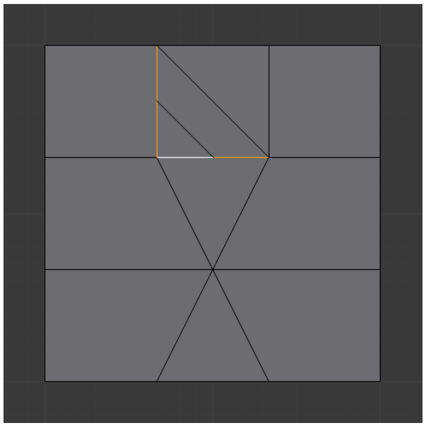
Quad/Tri Mode.

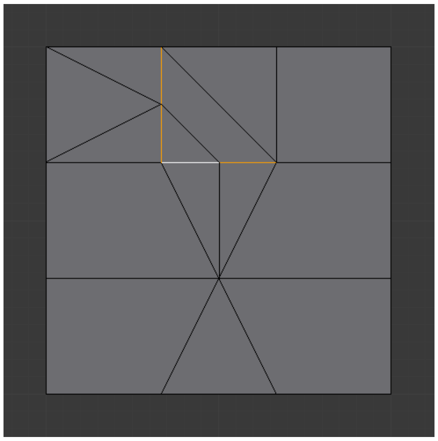


Inner vertices cut type.



Quad/Tri Mode.

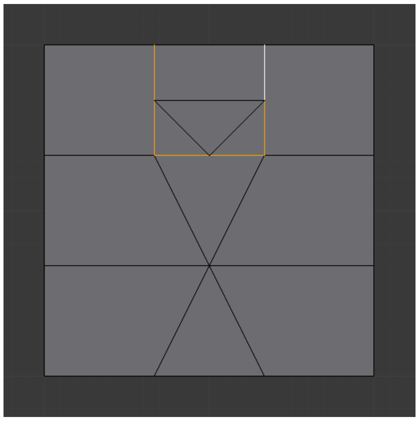


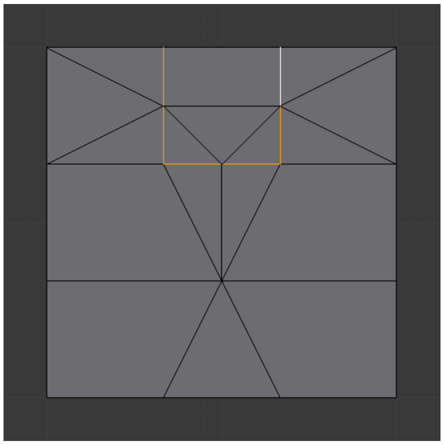


Path cut type.

Quad/Tri Mode.

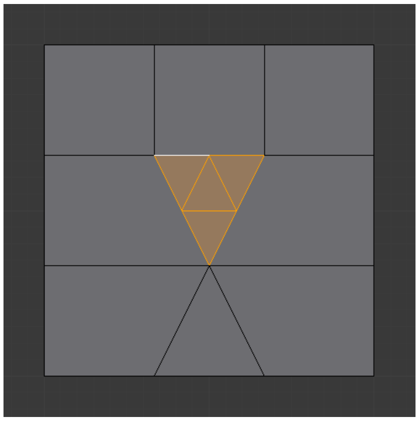
Three Edges

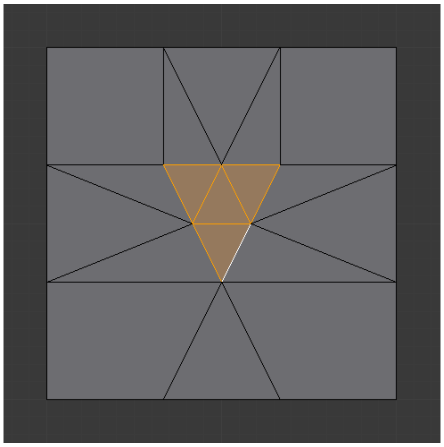




Quad/Tri Mode.

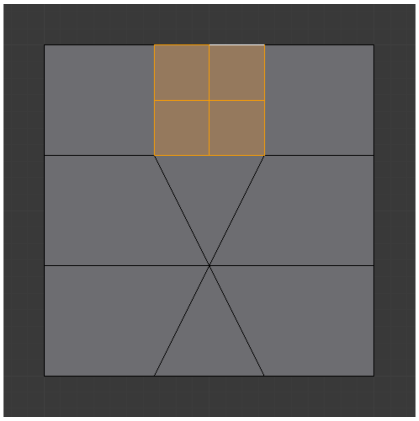
Tri

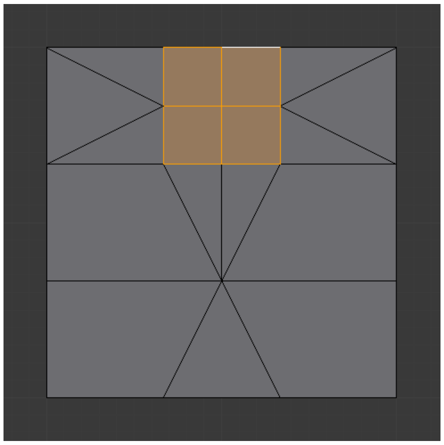




Quad/Tri Mode.

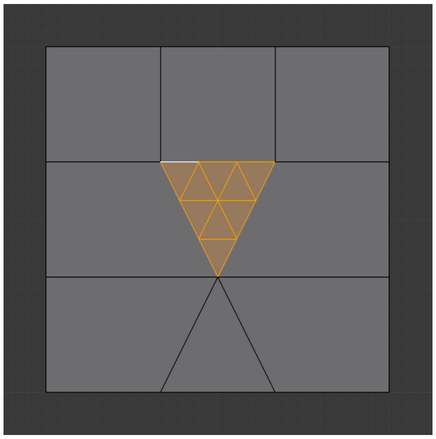
Quad/Four Edges



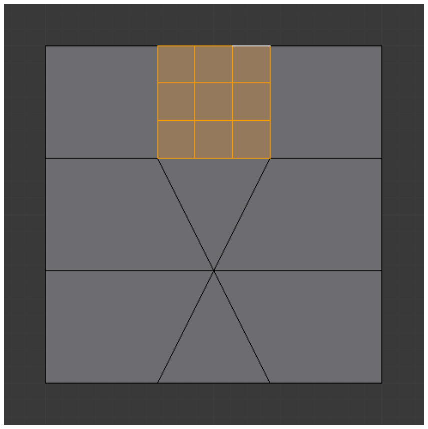


Quad/Tri Mode.

Multiple Cuts



Triangle with two cuts.



Quad with two cuts.

Subdivide Edge-Ring

Reference

Mode::	Edit Mode
Panel::	*Edge ‣ Subdivide Edge-Ring*

Take an edge ring, and subdivide with interpolation options.

Options
: See Bridge Edge Loops.

Un-Subdivide

Reference

Mode::	Edit Mode
Menu::	*Edge* ▸ *Un-Subdivide*

Un-subdivide functions as the reverse of subdivide by attempting to remove edges that were the result of a subdivide operation. If additional editing has been done after the subdivide operation, unexpected results may occur.

Iterations
How many subdivisions to remove.

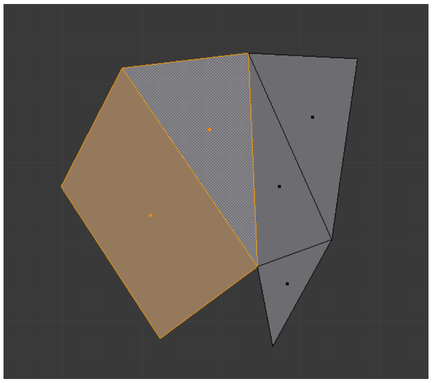
Rotate Edge

Reference

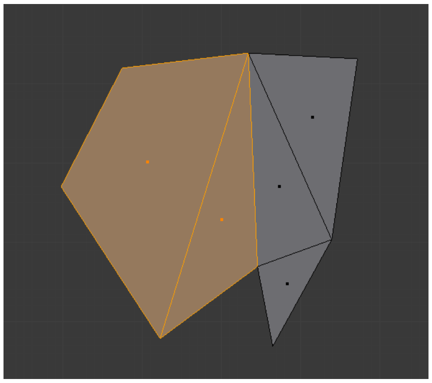
Mode:: Edit Mode
Menu:: *Edge* ▸ *Rotate Edge CW* / *Rotate Edge CCW*

Rotating an edge clockwise (CW) or counterclockwise (CCW) spins an edge between two faces around their vertices. This is very useful for restructuring a mesh's topology.

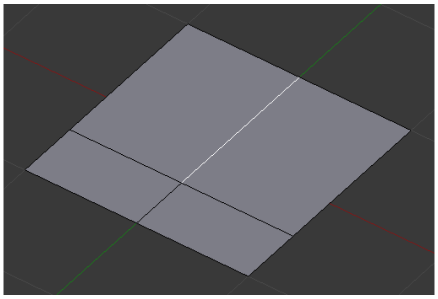
The tool operates on selected edges or the shared edge between selected faces.

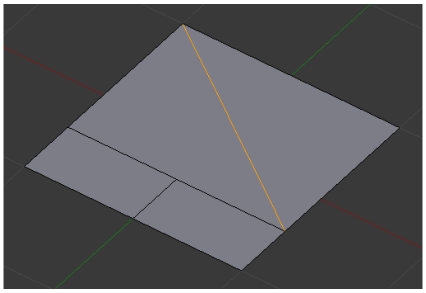


Two adjacent faces selected.



Selected edge rotated.





Selected edge. Edge, rotated CW.

Warning

To rotate an edge based on faces you must select adjacent face pairs, otherwise Blender notifies you with an error message, *“Could not find any selected edges that can be rotated”*. Using either *Rotate Edge CW* or *Rotate Edge CCW* will produce exactly the same results as if you had selected the common edge.

Edge Slide

Reference

Mode::	Edit Mode
Menu::	*Edge ‣ Edge Slide*
Shortcut::	`G`, `G`

Slides one or more edges across adjacent faces with a few restrictions involving the selection of edges (i.e. the selection *must* define a valid loop, see below).

Even `E`

Forces the edge loop to match the shape of the adjacent edge loop. You can flip to the opposite vertex using `F`.

Flipped `F`

When Even mode is active, this flips between the two adjacent edge loops the active edge loop will match.

Clamp `Alt` or `C`

Toggle clamping the slide within the edge extents.

Factor

Determines the amount of slide performed. Negative values correspond to slides toward one face, while positive ones, refer to the other one. It is also displayed in the 3D Viewport footer.

Mirror Editing

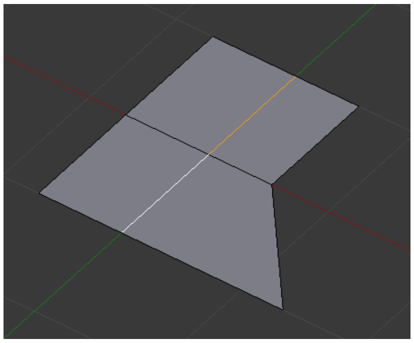
Lets you propagate the operation to the symmetrical elements of the mesh (if present, in local X direction).

Correct UVs

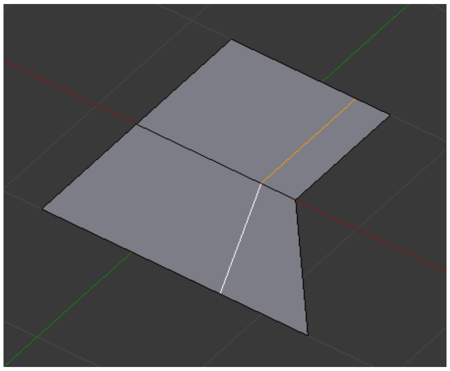
Corrects the corresponding UV coordinates, if these exist, to avoid image distortions.

Usage

By default, the position of vertices on the edge loop move as a percentage of the distance between their original position and the adjacent edge loop, regardless of the edges' lengths.



Selected edge loop.

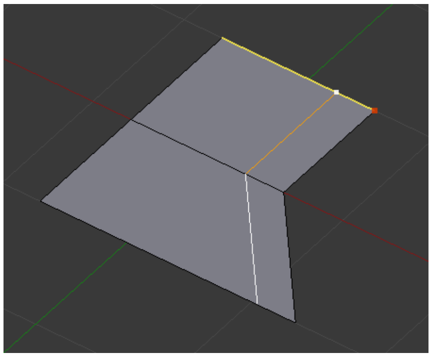


Repositioned edge loop.

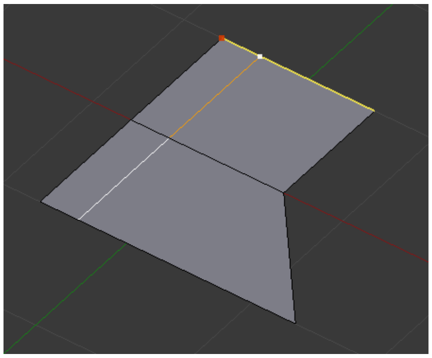
Even Mode

Even mode keeps the shape of the selected edge loop the same as one of the edge loops adjacent to it, rather than sliding a percentage along each perpendicular edge.

In *Even* mode, the tool shows the position along the length of the currently selected edge which is marked in yellow, from the vertex that has an enlarged red marker. Movement of the sliding edge loop is restricted to this length. As you move the mouse the length indicator in the header changes showing where along the length of the edge you are.



Even Mode enabled.



Even Mode with Flip enabled.

Moving the mouse moves the selected edge loop towards or away from the start vertex, but the loop line will only move as far as the length of the currently selected edge, conforming to the shape of one of the bounding edge loops.

Limitations & Workarounds

There are restrictions on the type of edge selections that can be operated upon. Invalid selections are:

Loop Crosses Itself

> This means that the tool could not find any suitable faces that were adjacent to the selected edge(s). An example that shows this is selecting two edges that share the same face. A face cannot be adjacent to itself.

Multiple Edge Loops

> The selected edges are not in the same edge loop, which means they do not have a common edge. You can minimize this error by always selecting edges end-to-end or in a “chain”. If you select multiple edges just make sure they are connected. This will decrease the possibility of getting looping errors.

Border Edges

> When a single edge was selected in a single-sided object. An edge loop cannot be found because there is only one face. Remember, edge loops are loops that span two or more faces.

A general rule of thumb is that if multiple edges are selected they should be connected end-to-end such that they form a continuous chain. This is *literally* a general rule because you can still select edges in a chain that are invalid because some of the edges in the chain are in different edge loops.

Offset Edge Slide

Reference

Mode::	Edit Mode
Menu::	*Edge ‣ Offset Edge Slide*
Shortcut::	`Shift-Ctrl-R`

Add two edge loops on either side of selected loops.

Cap Endpoint
Extends the loop by creating triangles at endpoints.

Factor
Location of the loop relative to the center loop and the outside edge loops.

Even
Only available for single edge loops. This matches the shape of the edge loop to one of the adjacent edge loops. (See Edge Slide tool for details.)

Flipped
When Even is enabled, this flips the target edge loop to match. (See Edge Slide tool for details.)

Clamp
Clamp within the edge extents.

Correct UVs
Correct UV coordinates when transforming.

Loop Cut and Slide

Reference

Mode::	Edit Mode
Menu::	*Edge ‣ Loop Cut and Slide*
Shortcut::	`Ctrl-R`

Loop Cut and Slide splits a loop of faces by inserting a new edge loop intersecting the chosen edge.

Usage

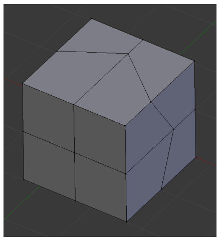
The tool is interactive and has two steps:

1. Pre-Visualizing the Cut

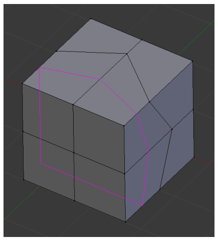
   After the tool is activated, move the cursor over a desired edge. The cut to be made is marked with a magenta colored line as you move the mouse over the various edges. The to be created edge loop stops at the poles (tris and n-gons) where the existing face loop terminates.

2. Sliding the new Edge Loop

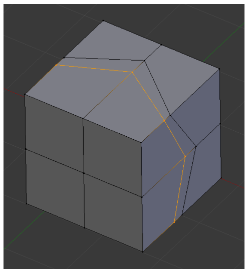
   Once an edge is chosen via `LMB`, you can move the mouse along the edge to determine where the new edge loop will be placed. This is identical to the Edge Slide tool. Clicking `LMB` again confirms and makes the cut at the pre-visualized location, or clicking `RMB` forces the cut to exactly 50%. This step is skipped when using multiple edge loops (see below).



Mesh before inserting edge loop.



Preview of edge loop location.



Interactive placement of edge loop between adjacent loops.

Options

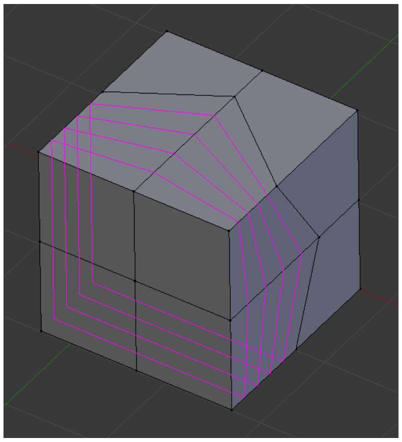
These options are available while the tool is in use, and later in the Adjust Last Operation panel.

Number of Cuts `Wheel` or `PageUp` / `PageDown`

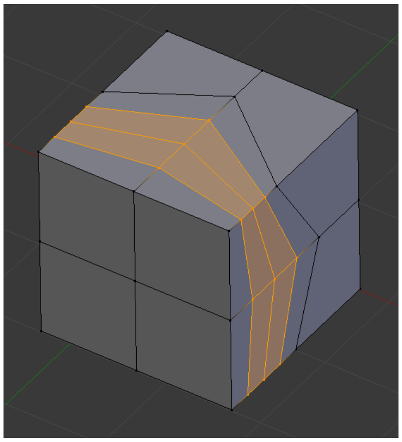
After activating the tool, but before confirming initial loop location, you can increase and decrease the number of cuts to create, by entering a number with the keyboard, scrolling `Wheel` or using `PageUp` and `PageDown`.

Note

When creating multiple loops, these cuts are uniformly distributed in the original face loop, and you will *not* be able to control their positions.



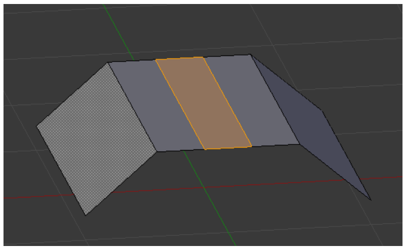
Preview of multiple edge loops.



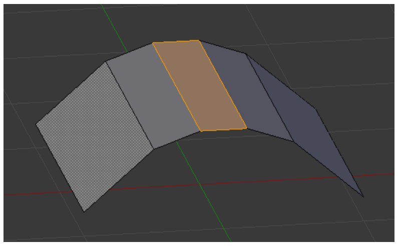
Result of using multiple cuts.

Smoothness `Alt-Wheel`

Smoothing causes edge loops to be placed in an interpolated position, relative to the face it is added to, causing them to be shifted outwards or inwards by a given percentage, similar to the *Subdivide Smooth* tool. When not using smoothing, new vertices for the new edge loop are placed exactly on the preexisting edges. This keeps subdivided faces flat, but can distort geometry, particularly when using Subdivision Surfaces. Smoothing can help maintain the curvature of a surface once it is subdivided.



Added edge loops without smoothing.



Same edge loops, but with smoothing value.

Falloff

Falloff type for *Smoothness*, changes the shape of the profile.

Factor
: Position of the edge loop relative to the surrounding edge loops.

Even `E`
: Only available for single edge loops. This matches the shape of the edge loop to one of the adjacent edge loops. (See Edge Slide tool for details.)

Flip `F`
: When Even is enabled, this flips the target edge loop to match. (See Edge Slide tool for details.)

Clamp
: Clamp within the edge extents.

Correct UVs
: Corrects the corresponding UV coordinates, if these exist, to avoid image distortions.

Edge Data

Edges can have several different properties that affect how certain other tools affect the mesh.

Edge Crease

Reference

Mode:: Edit Mode
Menu:: *Edge ▸ Edge Crease*
Shortcut:: `Shift-E`

This operator interactively sets the Edge Crease amount by moving the mouse (or typing a value with the keyboard). Selecting more than one edge will adjust the mean (average) crease value. A negative value will subtract from the actual crease value, if present. To clear the crease edge property, enter a value of -1.

Edge Bevel Weight

Reference

Mode:: Edit Mode
Menu:: *Edge ▸ Edge Bevel Weight*

Sets the value for the `bevel_weight_edge` attribute, a value between (0.0 to 1.0).

This attribute is used by the Bevel Modifier to control the bevel intensity of the edges.

This operator enters an interactive mode (a bit like transform tools), where by moving the mouse (or typing a value with the keyboard) you can set the bevel weight of selected edges. If more than one edge is selected, this operator alters the average weight of the edges.

See also

Vertex Bevel Weight

Mark Seam & Clear Seam

Reference

Mode:: Edit Mode
Menu:: *Edge ‣ Mark Seam/Clear Seam*

These operators set or unset this mark for selected edges. Seams are a way to create separations, "islands", in UV maps. See the UV Mapping section for more details.

Mark Sharp & Clear Sharp

Reference

Mode:: Edit Mode
Menu:: *Edge ‣ Mark Sharp/Clear Sharp*

Signifies the selected edge(s) as being "sharp". This edge attribute can either be set (mark) or unset (clear).

This influences the rendering of Normals to appear flat if smooth shading is enabled for the connecting face or object. This attribute can also be used by many modifiers or operators to mask their effect.

Internally, this uses the sharp edge attribute.

Set Sharpness by Angle

Reference

Mode::	Edit Mode
Menu::	*Edge* ▸ *Set Sharpness by Angle*

Sets the sharp edge attribute based on the angle between neighboring faces.

Angle
: Maximum angle between face normals that will be considered as smooth.

Extend
: Add new sharp edges without clearing existing sharp edges.

Face Operators

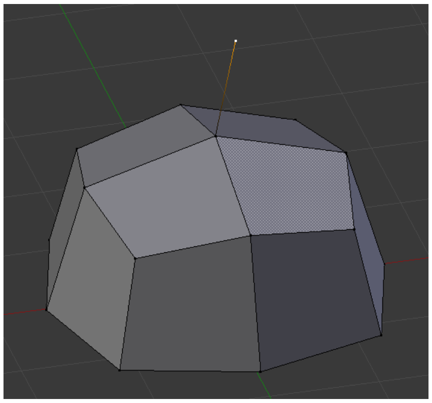
- Extrude Faces
- Extrude Faces Along Normals
- Extrude Individual Faces
- Inset Faces
  - Options
- Poke Faces
- Triangulate Faces
- Triangles to Quads
- Solidify Faces
- Wireframe
- Fill
- Grid Fill
- Beautify Faces
- Intersect (Knife)
- Intersect (Boolean)
- Weld Edges into Faces
- Shade Smooth & Flat
  - Shade Smooth
  - Shade Flat
- Face Data
  - Rotate Colors
  - Reverse Colors
  - Rotate UVs
  - Reverse UVs
  - Flip Quad Tessellation
  - Mark Freestyle Face
  - Clear Freestyle Face

Extrude Faces

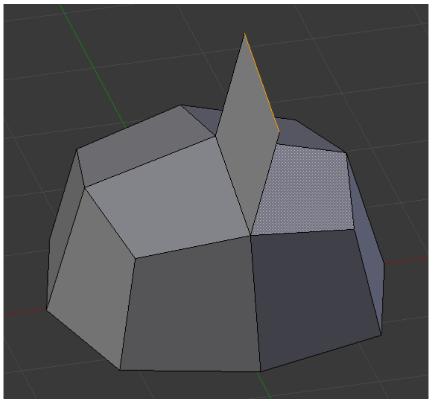
Reference

Mode:: Edit Mode
Menu:: *Face* ▸ *Extrude Faces*, *Mesh* ▸ *Extrude* ▸ *Extrude Faces*
Shortcut:: `E`

Extrude Faces duplicate faces, while keeping the new geometry connected with the original vertices.



Single vertex extruded.

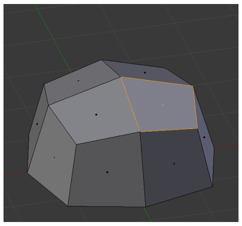


Single edge extruded.

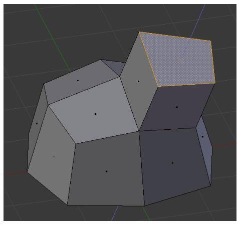
This tool is of paramount importance for creating new geometry. It allows you to create parallelepipeds from rectangles and cylinders from circles, as well as easily creating such things as tree limbs.

The axis on which faces are extruded along can be set interactively. Faces are extruded by default along their averaged normal. The extrusion can be limited to a single axis by specifying an axis; see Axis Locking.

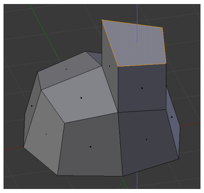
The extrude tools differentiate in how the new geometry is connected in itself. Only the border loop gets extruded. The inner region of the selection gets moved unchanged with the extrusion.



Selected face.



During extrude.



Set to Z axis.

Flip Normals

Only the *normals* of the new faces created from the extrusion will be flipped.

Dissolve Orthogonal Edges

Removes and connects edges whose faces form a flat surface and intersect new edges.

Orientation

Aligns the transformation axes to a specified orientation constraint. See Transform Orientations for more information.

Proportional Editing

The extruded face will affect nearby geometry. See Proportional Editing for a full reference.

Note

Even with the *Proportional Size* set to it's minimum, it will extrude the selected face as well as the new geometry and they will be layered on top of each other.

Extrude Faces Along Normals

Reference

Mode::	Edit Mode
Tool::	*Toolbar* ▸ *Extrude Along Normals*
Menu::	*Face* ▸ *Extrude Faces Along Normals*, *Mesh* ▸ *Extrude* ▸ *Extrude Faces Along Normals*
Shortcut::	`E`

Extrusion and offset will be locked in to only move along the local normals of the selected mesh.

Flip Normals

Only the *normals* of the new faces created from the extrusion will be flipped.

Dissolve Orthogonal Edges

Removes and connects edges whose faces form a flat surface and intersect new edges.

Offset

Amount to move geometry along the normals.

Offset Even

The length of the new edges will be uniform.

Proportional Editing

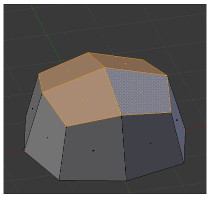
The extruded face will affect nearby geometry. See Proportional Editing for a full reference.

Extrude Individual Faces

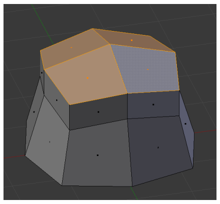
Reference

Mode:: Edit Mode
Tool:: *Toolbar ‣ Extrude Individual*
Menu:: *Face ‣ Extrude Individual Faces*, *Mesh ‣ Extrude ‣ Extrude Individual Faces*

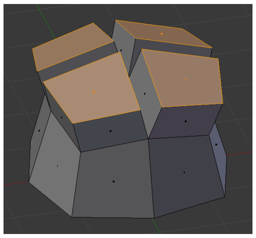
This tool allows you to extrude a selection of multiple faces as individuals, instead of as a region. The faces are extruded along their own normals, rather than their average. This has several consequences: first, "internal" edges (i.e. edges between two selected faces) are no longer deleted (the original faces are).



Selection of multiple faces.



Extruded using extrude region.



Extruded using Extrude Individual.

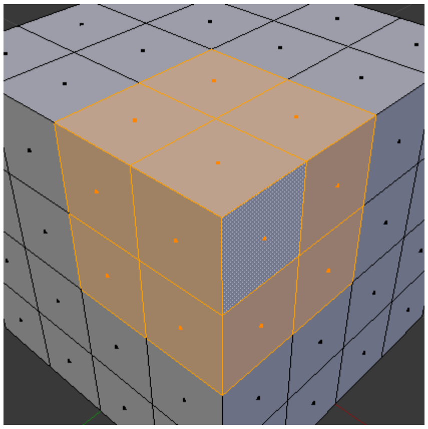
Inset Faces

Reference

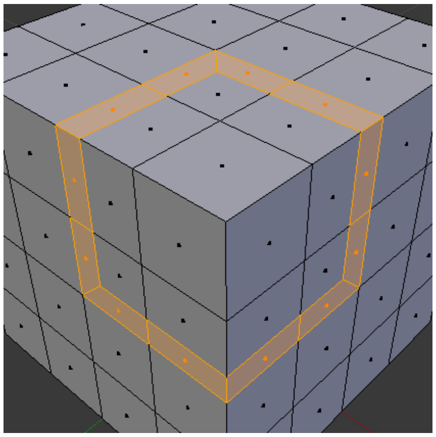
Mode::	Edit Mode
Tool::	*Toolbar ‣ Inset Faces*
Menu::	*Face ‣ Inset Faces*
Shortcut::	`I`

This tool takes the currently selected faces and creates an inset of them, with adjustable thickness and depth. Think of it as like creating an edge loop, but relative to the selected edges, even in complex meshes.

The tool is modal, such that when you activate it, you may adjust the thickness with your mouse position. You may also adjust the depth of the inset during the modal operation by holding `Ctrl`.

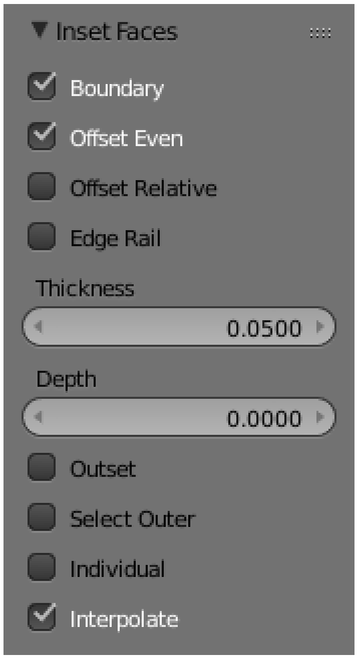


Selection to inset.



Result of inset with *Select Outer* enabled.

Options



▼ Inset Faces

☑ Boundary

☑ Offset Even

☐ Offset Relative

☐ Edge Rail

Thickness: 0.0500

Depth: 0.0000

☐ Outset

☐ Select Outer

☐ Individual

☑ Interpolate

Inset operator options.

Boundary `B`

Determines whether open edges will be inset or not.

Offset Even

Scale the offset to give a more even thickness.

Offset Relative

Scale the offset by lengths of surrounding geometry.

Edge Rail

Created vertices slide along the original edges of the inner geometry, instead of the normals.

Thickness

Set the size of the offset.

Depth `Ctrl`

Raise or lower the newly inset faces to add depth.

Outset `O`

Create an outset rather than an inset. Causes the geometry to be created surrounding selection (instead of within).

Select Outer

Toggle which side of the inset is selected after the operation.

Individual `I`

By default the Inset tool operates on the region around selected faces, but with this option each selected face can be inset on its own.

Interpolate

Interpolate mesh data: e.g. UVs, Color Attribute’s colors, weights, etc.

Poke Faces

Reference

Mode::	Edit Mode
Menu::	*Face ‣ Poke Faces*

Splits each selected faces into a triangle fan, creating a new center vertex and triangles between the original face edges and new center vertex. The *Offset* can be used to make spikes or depressions.

Poke Offset
  Offset the new center vertex along the face normal.

Offset Relative
  Multiply the Offset by the average length from the center to the face vertices.

Poke Center
  Computes the center of a face.

Weighted Median::	Using the mean average weighted by edge length.
Median::	Using the mean average.
Bounds::	Uses center of bounding box.

Triangulate Faces

Reference

Mode::	Edit Mode
Menu::	*Face ‣ Triangulate Faces*
Shortcut::	`Ctrl-T`

This tool converts each of the selected faces (whether it be quads or n-gons) to triangular faces. See the Triangulate Modifier.

Triangles to Quads

Reference

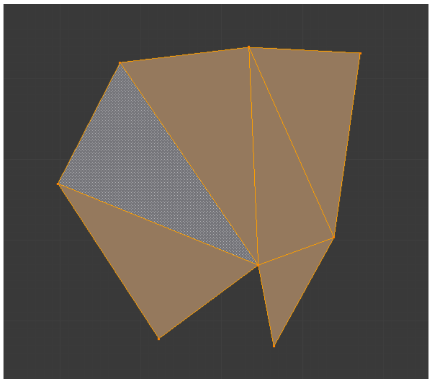
Mode:: Edit Mode
Menu:: *Face ▸ Triangles to Quads*
Shortcut:: `Alt-J`

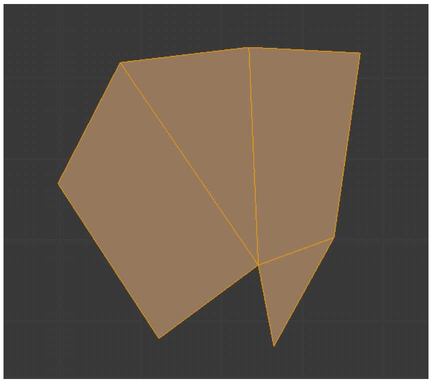
This tool converts the selected triangles into quads by taking adjacent triangles and removing the shared edge to create a quad, based on a threshold. This tool can be applied on a selection of multiple triangles.

This means you can select the entire mesh and convert triangles that already form square shapes – to be converted into quads, without having to concern yourself with individual faces.

Alternatively you can force this operation selecting a pairs of faces (see hint below for other ways of joining).

To create a quad, this tool needs at least two adjacent triangles. If you have an even number of selected triangles, it is also possible not to obtain only quads. In fact, this tool tries to create most even rectangular quads from the given triangles, which means some triangles could remain.





Before converting tris to quads.

After converting tris to quads.

Max Angle

This value, between (0 to 180), controls the threshold for this tool to work on adjacent triangles. With a threshold of 0.0, it will only join adjacent triangles that form a perfect rectangle (i.e. right-angled triangles sharing their hypotenuses). Larger values are required for triangles with a shared edge that is small, relative to the size of the other edges of the triangles.

Compare UVs

Prevents the union of triangles that are not also adjacent in the active UV map.

Compare Color Attributes

Prevents the union of triangles that do not have matching Color Attributes.

Compare Sharp

Prevents the union of triangles that share an edge marked as sharp.

Compare Materials

Prevents the union of triangles that do not have the same material assigned.

Hint

When isolated groups of faces are selected, they can be combined with Create Face or Dissolve Faces; this is not limited to quads.

Solidify Faces

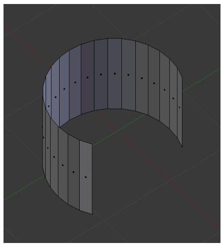
Reference

Mode::	Edit Mode
Menu::	*Face ‣ Solidify Faces*

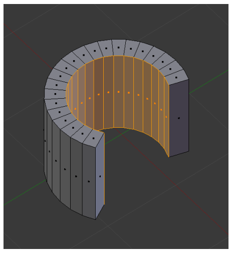
This takes a selection of faces and solidifies them by extruding them uniformly to give volume to a Non-manifold surface. This is also available as a Modifier. After using the tool, you can set the offset distance in the Adjust Last Operation panel.

Thickness

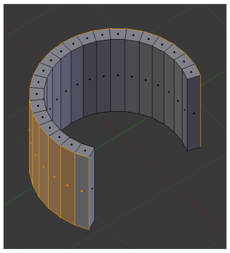
Amount to offset the newly created surface. Positive values offset the surface inward relative to the normals direction. Negative values offset outward.



Mesh before solidify operation.



Solidify with a positive thickness.



Solidify with a negative thickness.

Wireframe

Reference

Mode:: Edit Mode
Menu:: *Face ‣ Wireframe*

The Wireframe tool makes a wireframe from faces by turning edges into wireframe tubes, similar to the Wireframe Modifier.

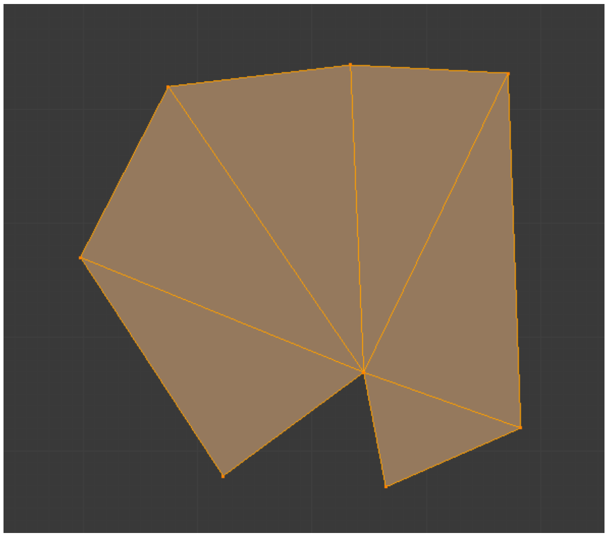
Fill

Reference

Mode::	Edit Mode
Menu::	*Face* ▸ *Fill*
Shortcut::	`Alt-F`

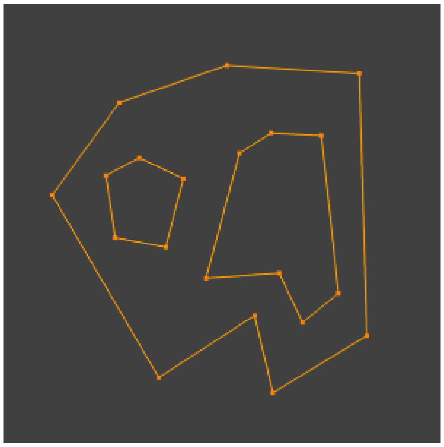
The *Fill* option will create *triangular* faces from any group of selected edges or vertices, as long as they form one or more complete perimeters.

Beauty
  Arrange the new triangles nicely.

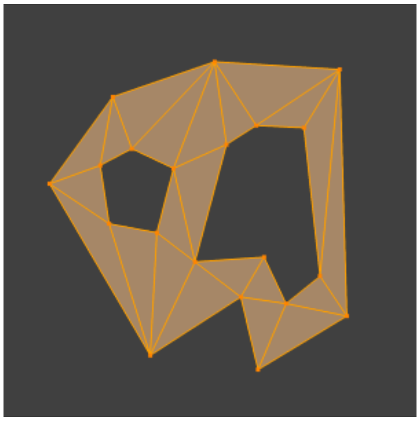


Filled using fill.

Note, unlike creating n-gons, *Fill* supports holes.



A closed perimeter of edges with holes.



Filled using fill.

Grid Fill

Reference

Mode::	Edit Mode
Menu::	*Face ‣ Grid Fill*

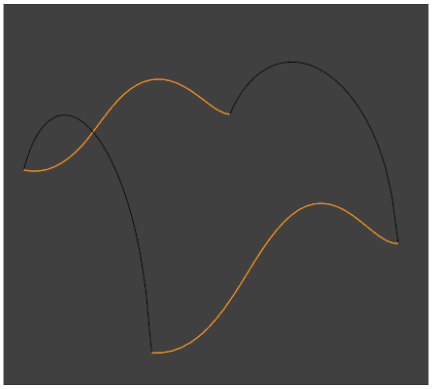
Grid Fill uses a pair of connected edge loops or a single, closed edge loop to fill in a grid that follows the surrounding geometry.

The best predictable result can be achieved if you select two opposite edge loops with an equal number of vertices. When a single, closed edge loop is selected, the Span/Offset options allows you to adjust the way two opposite edge loops are detected from one closed edge loop.

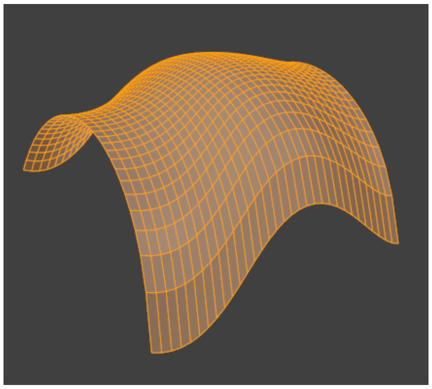
Span
: Specifies the number of columns in the grid.

Offset
: Defines the vertex that is considered to be the corner of the grid, by default, it's the active vertex. The Offset allows you to rotate the grid lines.

Simple Blending
: Use a simple interpolation algorithm to generate grid vertices from boundary loops, which does not tries to maintain the shape, useful for flat surfaces or times when keeping the shape gives odd results.



Input.



Grid Fill result.

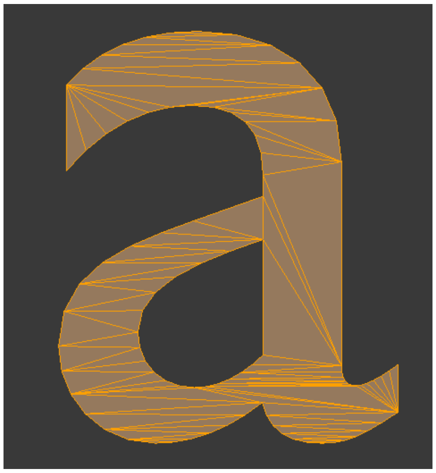
Beautify Faces

Reference

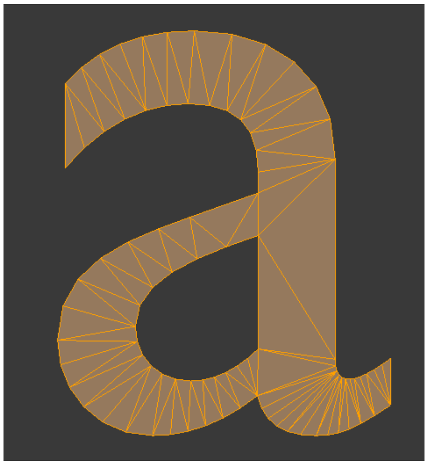
Mode:: Edit Mode
Menu:: *Face ‣ Beautify Faces*

Beautify Faces works only on selected existing faces. It rearrange selected triangles to obtain more "balanced" ones (i.e. less long thin triangles).

Max Angle
An angle delimiter option to limit edge rotation to flat surfaces.



Text converted to a mesh.



Result of Beautify Faces.

Intersect (Knife)

Reference

Mode:: Edit Mode
Menu:: *Face ▸ Intersect (Knife)*

The Intersect tool lets you cut intersections into geometry. It is a bit like the Boolean tool, but, does not calculate interior/exterior geometry. Faces are split along the intersections, leaving new edges selected.

Source

- **Self Intersect::** Operate on the overlapping geometry of the mesh.
- **Selected/Unselected::** Operate between the selected and unselected geometry.

Separate Mode

- **All::** Splits the geometry at the new edge.
- **Cut::** Keep each side of the intersection separate without splitting the faces in half.
- **Merge::** Merge all the geometry from the intersection.

Solver

Algorithm used to calculate the intersections.

- **Fast::** Uses a mathematically simple solver which offers the best performance; however, this solver lacks support for overlapping geometry.

  Merge Threshold

  Tolerance for close faces to be considered touching. It may be useful to increase this when some intersections aren't detected that should be and when extra geometry is being created because edges aren’t detected as overlapping.

> **Warning**
> A threshold approaching the size of faces may cause very slow calculation, in general keep this value small.

Exact::	Uses a mathematically complex solver which offers the best results and has full support for overlapping geometry; however, this solver is much slower than the *Fast Solver*.

Intersect (Boolean)

Reference

Mode:: Edit Mode
Menu:: *Face ‣ Intersect (Boolean)*

Performs Boolean operations with the selection on the unselected geometry. While the Boolean Modifier is useful for non-destructive edits, access to these operations with a tool in Edit Mode can be useful to quickly perform edits.

Boolean Operation

Intersect:: Opposite of *Difference* (everything *inside* of the target mesh is kept).
Union:: The target mesh is added to the modified mesh.
Difference:: The target mesh is subtracted from the modified mesh (everything *outside* of the target mesh is kept).

Solver

Algorithm used to calculate the Boolean intersections.

Fast:: Uses a mathematically simple solver which offers the best performance; however, this solver lacks support for overlapping geometry.

Merge Threshold

Tolerance for close faces to be considered touching. It may be useful to increase this when some intersections aren't detected that should be and when extra geometry is being created because edges aren't detected as overlapping.

Warning

A threshold approaching the size of faces may cause very slow calculation, in general keep this value small.

Exact:: Uses a mathematically complex solver which offers the best results and has full support for overlapping geometry; however, this solver is much slower than the *Fast Solver*.

Swap

Changes the order of the operations when using *Difference* to determine which side is kept.

Self Intersection

Correctly calculates cases when one or both operands have self-intersections, this involves more calculations making it slower.

Weld Edges into Faces

Reference

Mode::	Edit Mode
Menu::	*Face ‣ Weld Edges into Faces*

A tool to split selected faces by loose wire edges. This can be used in a similar way to the Knife tool, but the edges are manually setup first.

Shade Smooth & Flat

The appearance of the mesh edges are determined to be evened out or well defined within the 3D Viewport and render. In Edit Mode, individual faces can be selected to determine which faces are smoothed or flattened.

Note

Both Shade Smooth and Flat are also available in Object Mode and function the same way.

Shade Smooth

Reference

Mode::	Edit Mode
Menu::	*Face ‣ Shade Smooth*

Using interpolated vertex normals, the mesh faces will blur at the edges and appear smooth.

Shade Flat

Reference

Mode::	Edit Mode
Menu::	*Face ‣ Shade Flat*

Face normals are displayed evenly, because of this all the edges of the selected mesh will be easily visible.

Tip

Use the Edge Split modifier and Smooth by Angle Smooth to balance between smooth surfaces and sharp edges.

Face Data

Rotate Colors

Reference

Mode::	Edit Mode
Menu::	*Face ‣ Face Data ‣ Rotate Colors*

Rotates the Color Attribute’s colors inside faces either clockwise or counterclockwise.

Reverse Colors

Reference

Mode::	Edit Mode
Menu::	*Face ‣ Face Data ‣ Reverse Colors*

Flips the direction of Color Attribute’s colors inside the selected faces.

Rotate UVs

Reference

Mode::	Edit Mode
Menu::	*Face ‣ Face Data ‣ Rotate UVs*

See Rotate UVs.

Reverse UVs

Reference

Mode::	Edit Mode
Menu::	*Face ‣ Face Data ‣ Reverse UVs*

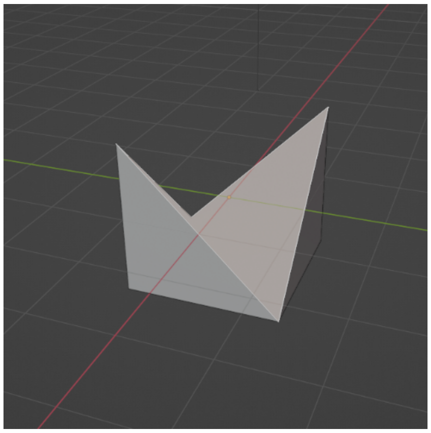
See Reverse UVs.

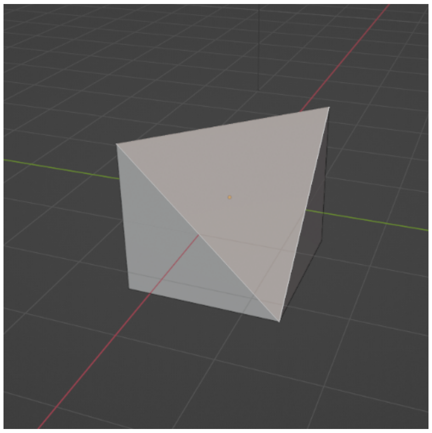
Flip Quad Tessellation

Reference

Mode::	Edit Mode
Menu::	*Face ‣ Face Data ‣ Flip Quad Tessellation*

Internally, all quads are Tessellated into 2 triangles, this operator swaps which way the quad is split into triangles.





Mark Freestyle Face

Reference

Mode::	Edit Mode
Menu::	*Face ‣ Face Data ‣ Mark Freestyle Face*

Todo.

Clear Freestyle Face

Reference

Mode::	Edit Mode
Menu::	*Face* ▸ *Face Data* ▸ *Clear Freestyle Face*

Todo.

UV Operators

Reference

Editor::	3D Viewport
Mode::	Edit Mode
Menu::	*Header ‣ UV*
Shortcut::	`U`

Blender offers several ways of mapping UVs. The simpler projection methods use formulas that map 3D space onto 2D space, by interpolating the position of points toward a point/axis/plane through a surface. The more advanced methods can be used with more complex models, and have more specific uses.

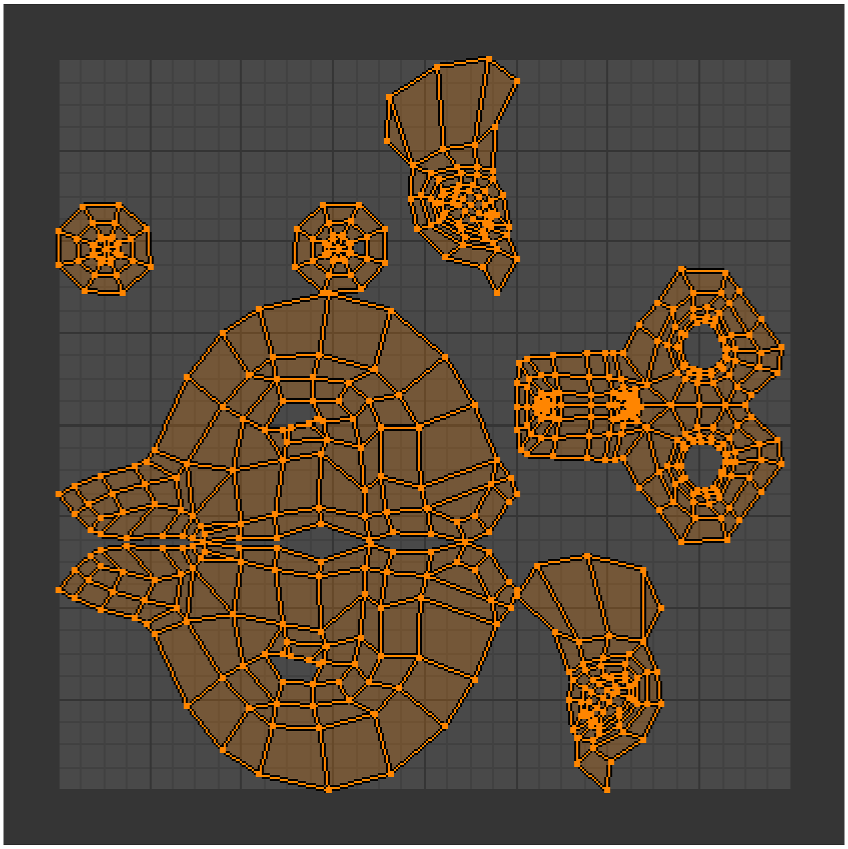
Unwrap

Reference

Editor::	3D Viewport and UV Editor
Mode::	Edit Mode
Menu::	*UV ‣ Unwrap*
Shortcut::	`U`

Flattens the mesh surface by cutting along seams. Useful for organic shapes.

Begin by selecting all the faces you want to unwrap. In the 3D Viewport, select *UV ‣ Unwrap* or `U` and select *Unwrap*. You can also do this from the UV Editor with *UV ‣ Unwrap* or `U`. This method will unwrap all faces and reset previous work. The UVs menu will appear in the UV Editor after unwrapping has been performed once.



Result of unwrapping Suzanne.

This operation unwraps the faces of the object to provide the “best fit” scenario based on how the faces are connected and will fit within the image, and takes into account any seams within the selected faces. If possible, each selected face gets its own different area of the image and is not overlapping any other faces UVs. If all faces of an object are selected, then each face is mapped to a part of the image.

Tip

A face’s UV image texture only has to use *part* of the image, not the *whole* image. Also, portions of the same image can be shared by multiple faces. A face can be mapped to less and less of the total image.

Options

The Adjust Last Operation panel allows fine control over how a mesh is unwrapped:

Method

Angle Based::	Uses Angle Based Flattening (ABF). This method gives a good 2D representation of a mesh.
Conformal::	Uses Least Squares Conformal Mapping (LSCM). This usually results in a less accurate UV mapping than Angle Based, but performs better on simpler objects.
Minimum Stretch::	Uses Scalable Locally Injective Mapping (SLIM). This tries to balance minimizing area distortion and minimizing angle distortion.

Fill Holes

Activating Fill Holes will prevent overlapping from occurring and better represent any holes in the UV regions.

Correct Aspect

Map UVs will take the image’s aspect ratio into consideration. If an image has already been mapped to the Texture Space that is non-square, the projection will take this into account and distort the mapping to appear correctly.

Use Subdivision Surface

Map UVs taking vertex position after Subdivision Surface Modifier into account.

Iterations

The Minimum Stretch method is iterative, where each iteration reduces the distortion more. This option says how many iterations to use before stopping.

Allow Flips

When using the Minimum Stretch method this option allows faces to flip, which sometimes results in less distortion when there are pins.

Importance Weights

The Minimize Stretch method has a feature that allows a user-specified vertex group to control the relative amount of area used by different parts of the unwrapped map. Vertices with higher weights will mark portions of the mesh whose adjacent UV map faces should be stretched larger than smaller-weight areas. When this option is chosen, there are two additional options to control this:

Attribute::	The name of the vertex group with the weights to be used.
Factor::	A global factor to multiply all the weights. A bigger number will result in a more exaggerated difference between high-weight and low-weight areas.

Margin Method
The method to use when calculating the empty space between islands.

Scaled::	Use scale of existing UVs to multiply margin.
Add::	Simple method, just add the margin.
Fraction::	Precisely specify the fraction of the UV unit square for margin. (Slower than other two methods.)

Margin
The scale for the empty space between islands.

Smart UV Project

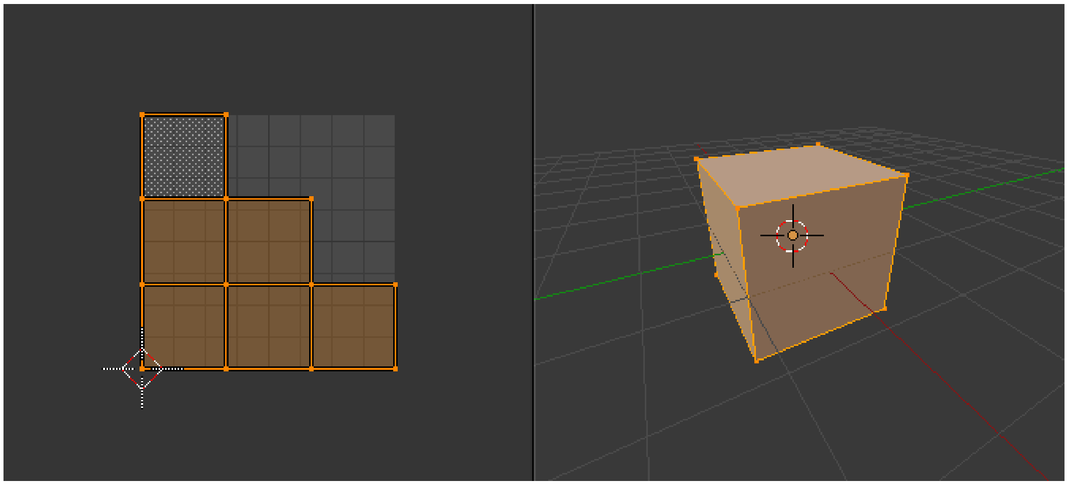
Reference

Editor::	3D Viewport
Mode::	Edit Mode
Menu::	*UV ‣ Smart UV Project*
Shortcut::	`U`

Smart UV Project, cuts a mesh based on an angle threshold (angular changes in your mesh). This gives you fine control over how automatic seams are created. It is a good method for simple and complex geometric forms, such as mechanical objects or architecture.

This algorithm examines the shape of your object, the selected faces and their relation to one another, and creates a UV map based on this information and settings that you supply.

In the example below, the Smart Mapper mapped all of the faces of a cube to a neat arrangement of three sides on top, three sides on the bottom, for all six sides of the cube to fit squarely, just like the faces of the cube.



Smart UV project on a cube.

For more complex mechanical objects, this operator can quickly and easily create a regular and straightforward UV layout.

Options

The Adjust Last Operation panel allows fine control over how a mesh is unwrapped:

Angle Limit

> This controls how faces are grouped: a higher limit will lead to many small groups but less distortion, while a lower limit will create fewer groups at the expense of more distortion.

Margin Method

The method to use when calculating the empty space between islands.

Scaled::	Use scale of existing UVs to multiply margin.
Add::	Simple method, just add the margin.
Fraction::	Precisely specify the fraction of the UV unit square for margin. (Slower than other two methods.)

Rotation Method

Axis-aligned::	Rotated to a minimal rectangle, either vertical or horizontal.
Axis-aligned (Horizontal)::	Rotate islands to be aligned horizontally.
Axis-aligned (Vertical)::	Rotate islands to be aligned vertically.

Island Margin

This controls how tightly the UV islands are packed together. A higher number will add more space between islands.

Area Weight

Weight projection’s vector by faces with larger areas.

Correct Aspect

Map UVs will take the image’s aspect ratio into consideration. If an image has already been mapped to the Texture Space that is non-square, the projection will take this into account and distort the mapping to appear correctly.

Scale to Bounds

If the UV map is larger than the (0 to 1) range, the entire map will be scaled to fit inside.

Lightmap Pack

Reference

Editor::	3D Viewport
Mode::	Edit Mode
Menu::	*UV ‣ Lightmap Pack*
Shortcut::	`U`

Lightmap Pack takes each of a mesh's faces, or selected faces, and packs them into the UV bounds. Lightmaps are used primarily in realtime rendering, where lighting information is baked onto texture maps, when it is needed to use as much UV space as possible. It has several options that appear in the Adjust Last Operation panel:

Options

Selection

Selected Faces::	Only unwraps the selected faces.
All Faces::	Unwraps the whole mesh.

Share Texture Space
: This is useful if mapping more than one mesh. It attempts to fit all of the objects' faces in the UV bounds without overlapping.

New UV Map
: If mapping multiple meshes, this option creates a new UV map for each mesh. See UV Maps.

Pack Quality
: Pre-packing before the more complex Box packing.

Margin
: This controls how tightly the UV islands are packed together. A higher number will add more space between islands.

Follow Active Quads

Reference

Editor::	3D Viewport

Mode:: Edit Mode
Menu:: *UV ‣ Follow Active Quads*
Shortcut:: `U`

Extrapolate UV's based on the active quad by following continuous face loops, even if the mesh face is irregularly-shaped.

Note

For a clean 90-degree unwrap it's typically best to first make sure the quad a rectangle in UV space.

Otherwise any distortion in the active UV is extended which doesn't result in a useful grid-layout.

Note

The resulting unwrap is not clamped within the UV bounds, you may wish to scale down the active quad's UV's so the result is in a usable range.

Options

Edge Length Mode

Method to space UV edge loops.

Even:: Space all UVs evenly, where the shape of the quad in the 3D viewport is ignored.

Length:: Each face's UV's are calculated based on the edge length.
While this minimizes distortion, adjacent loops may become disconnected.

Length Average:: Average space UVs edge length of each loop.

This has the benefit of minimizing distortion, while keeping UV's connected.

Cube Projection

Reference

Editor::	3D Viewport
Mode::	Edit Mode
Menu::	*UV ‣ Cube Projection*
Shortcut::	`U`

Cube Projection maps the mesh onto the faces of a cube, which is then unfolded. It projects the mesh onto six separate planes, creating six UV islands. In the UV editor, these will appear overlapped, but can be moved. See Editing UVs.

Options

Cube Size
  Set the size of the cube to be projected onto.

Correct Aspect
  Map UVs will take the image's aspect ratio into consideration. If an image has already been mapped to the Texture Space that is non-square, the projection will take this into account and distort the mapping to appear correctly.

Clip to Bounds
  Any UVs that lie outside the (0 to 1) range will be clipped to that range by being moved to the UV space border it is closest to.

Scale to Bounds
  If the UV map is larger than the (0 to 1) range, the entire map will be scaled to fit inside.

Cylinder Projection

Reference

Editor:: 3D Viewport
Mode:: Edit Mode
Menu:: *UV ‣ Cylinder Projection*
Shortcut:: `U`

Normally, to unwrap a cylinder (tube) as if you slit it lengthwise and folded it flat, Blender wants the view to be vertical, with the tube standing “up”. Different views will project the tube onto the UV map differently, skewing the image if used. However, you can set the axis on which the calculation is done manually.

Options

Direction

View on Poles:: Use when viewing from the top (at a pole) by using an axis that is straight down from the view.
View on Equator:: Use if view is looking at the equator, by using a vertical axis.
Align to Object:: Uses the object’s transform to calculate the axis.

Align

How to determine rotation around the pole.

Polar ZX:: Polar 0 is on the X axis.
Polar ZY:: Polar 0 is on the Y axis.

Pole

How to handle faces at the poles.

Pinch:: UVs are pinched at the poles.
Fan:: UVs are fanned at the poles.

Preserve Seams

Separate projections by islands isolated by seams.

Radius
The radius of the cylinder to use.

Correct Aspect
Map UVs will take the image's aspect ratio into consideration. If an image has already been mapped to a Texture Space that is non-square, the projection will take this into account and distort the mapping to appear correctly.

Clip to Bounds
Any UVs that lie outside the (0 to 1) range will be clipped to that range by being moved to the UV space border it is closest to.

Scale to Bounds
If the UV map is larger than the (0 to 1) range, the entire map will be scaled to fit inside.

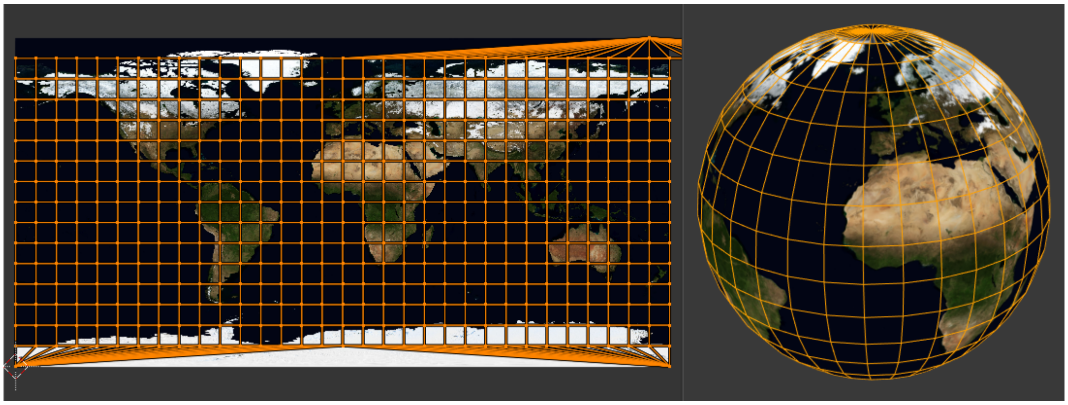
Sphere Projection

Reference

Editor::	3D Viewport
Mode::	Edit Mode
Menu::	*UV ‣ Sphere Projection*
Shortcut::	`U`

Spherical mapping is similar to cylinder but the difference is that a cylindrical mapping projects the UVs on a plane toward the cylinder shape, while a spherical map takes into account the sphere's curvature, and each latitude line becomes evenly spaced. *Sphere Projection* is useful for spherical shapes, like eyes, planets, etc.

Recall the opening cartographer's approaching to mapping the world? Well, you can achieve the same here when unwrapping a sphere from different points of view. Normally, to unwrap a sphere, view the sphere with the poles at the top and bottom. After unwrapping, Blender will give you an equirectangular projection; the point at the equator facing you will be in the middle of the image. A polar view will give a very different but common projection map. Using an equirectangular projection map of the earth as the UV image will give a good planet mapping onto the sphere.



Using an equirectangular image with a Sphere Projection.

Options

Direction

Direction of the sphere.

View on Poles::	Use when viewing from the top (at a pole) by using an axis that is straight down from the view.
View on Equator::	Use if view is looking at the equator, by using a vertical axis.
Align to Object::	Uses the object’s transform to calculate the axis.

Align

Select which axis is up.

Polar ZX::	Polar 0 is on the X axis.
Polar ZY::	Polar 0 is on the Y axis.

Pole

How to handle faces at the poles.

Pinch::	UVs are pinched at the poles.
Fan::	UVs are fanned at the poles.

Preserve Seams

Separate projections by islands isolated by seams.

Correct Aspect

Map UVs will take the image's aspect ratio into consideration. If an image has already been mapped to a Texture Space that is non-square, the projection will take this into account and distort the mapping to appear correctly.

Clip to Bounds

Any UVs that lie outside the (0 to 1) range will be clipped to that range by being moved to the UV space border it is closest to.

Scale to Bounds

If the UV map is larger than the (0 to 1) range, the entire map will be scaled to fit inside.

Project from View

Reference

Editor::	3D Viewport
Mode::	Edit Mode
Menu::	*UV ‣ Project from View*
Shortcut::	`U`

Project from View takes the current view in the 3D Viewport and flattens the mesh as it appears. Use this option if you are using a picture of a real object as a UV Texture for an object that you have modeled. You will get stretching in areas where the model recedes away from you.

Options

Orthographic

Apply an orthographic projection.

Camera Bounds
: Map UVs to the camera region taking resolution and aspect into account

Correct Aspect
: Map UVs will take the image's aspect ratio into consideration. If an image has already been mapped to a Texture Space that is non-square, the projection will take this into account and distort the mapping to appear correctly.

Clip to Bounds
: Any UVs that lie outside the (0 to 1) range will be clipped to that range by being moved to the UV space border it is closest to.

Scale to Bounds
: If the UV map is larger than the (0 to 1) range, the entire map will be scaled to fit inside.

Project from View (Bounds)

Reference

Editor::	3D Viewport
Mode::	Edit Mode
Menu::	*UV ‣ Project from View (Bounds)*
Shortcut::	`U`

The same as Project from View, but with *Scale to Bounds* activated by default.

Reset

Reference

Editor::	3D Viewport and UV Editor

Mode:: Edit Mode
Menu:: *UV ‣ Reset*
Shortcut:: `U`

Reset UVs maps each face to fill the UV grid, giving each face the same mapping.

If you want to use an image that is tileable, the surface will be covered in a smooth repetition of that image, with the image skewed to fit the shape of each individual face. Use this unwrapping option to reset the map and undo any unwrapping (go back to the start).

Properties

- Object Data
  - Vertex Groups
  - Shape Keys
  - UV Maps
  - Color Attributes
  - Attributes
  - Texture Space
  - Remesh
  - Geometry Data
- Vertex Groups
  - Introduction
  - Vertex Groups Panel
  - Assigning a Vertex Group
  - Vertex Weights
- Geometry Data

Object Data

Meshes

The mesh Data-Block Menu can be used to link the data between objects.

Vertex Groups

Vertex groups can be used to assign a group or weighted group to some operator. An object can have several weight groups and can be assigned in Weight Paint mode, or in Edit Mode via this panel.

See Vertex Groups for more information.

Shape Keys

Shape Keys can be used to transform one shape into another. See Shape Keys Panel for more information.

UV Maps

UV Maps are used to map a 3D object onto a 2D plane that determines where a texture appears on the 3D object. Different UV Maps can be used for different textures. For more information see UV Maps.

Color Attributes

Color data can be applied directly to an object’s vertices rather than using a texture or a material. There are two modes to paint color attributes in. Use Vertex Paint mode to paint per face corner by enabling the paint mask in the header. This is useful to achieve sharp edges in the color attribute on low-poly assets. Alternatively use Sculpt mode to paint on a much higher vertex count.

Creating a New Color Attribute

To create a new Color Attribute select the plus icon next to the list of attributes. This action will open a pop-up with the following information.

Name

The name of the Color Attribute which can be referenced elsewhere in Blender.

Domain

The associated part of the geometry that stores the attribute. See Attribute Domains for more information.

Vertex::	Color Attributes are stored per each vertex.
Face Corner::	Color Attributes are stored per each corner of a face.

Data Type

The data type to represent colors internally.

Color::	RGBA color with floating-point precision.
Byte Color::	RGBA color with 8-bit precision.

Color

The default color to fill for every element in the domain.

Color Attribute Specials

These are operators that are available in the menu to the right of the attribute list.

Duplicate Color Attribute

Creates a copy of the active color attribute in the list.

Convert Color Attribute

Changes how the color attribute is stored.

Domain

The associated part of the geometry that stores the attribute. See Attribute Domains for more information.

Vertex::	Color Attributes are stored per each vertex.
Face Corner::	Color Attributes are stored per each corner of a face.

Data Type

The data type to represent colors internally.

Color::	RGBA color with floating-point precision.
Byte Color::	RGBA color with 8-bit precision.

Attributes

An attribute is data stored per mesh element. Every attribute has a data type, domain and name. This panel only lists custom attributes which excludes all the built-in attributes like `position` and other attributes like vertex groups.

See Attributes Reference for more information.

Texture Space

Each object can have an automatically generated UV map, these maps can be adjusted here.

See Generated UV Properties for more information.

Remesh

Mesh objects, in particular meshes that have been modeled to represent organic objects, often have geometry that is not particularly uniform. This can cause problems if the object needs to be rigged or just needs simpler geometry for workflows such as 3D printing. Remeshing is a technique that rebuilds the geometry with a more uniform topology. Remeshing can either add or remove the amount of topology depending on the defined resolution.

Remeshing is especially useful for sculpting, to generate better topology after blocking out the initial shape.

See Mesh Retopology for more information.

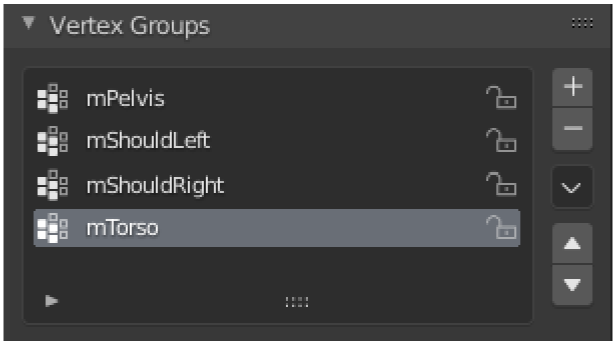
Geometry Data

Mesh objects can have different types of custom data attached to them. This data is mostly used internally and can be exported by some exporters. See Geometry Data for more information.

Vertex Groups

- Introduction
    - Usage
- Vertex Groups Panel
    - Editing Vertex Groups
- Assigning a Vertex Group
    - Creating Vertex Groups
    - Deleting Vertex Groups
    - Locking Vertex Groups
    - Working with Content of Vertex Groups
- Vertex Weights
    - Vertex Group Categories
    - Weight Table
    - Operators
    - Locking

Introduction



The Vertex Groups panel.

Vertex groups are mainly used to tag the vertices belonging to parts of a mesh object or Lattice. Think of the legs of a chair or the hinges of a door, or hands, arms, limbs, head, feet, etc. of a character. In addition you can assign different weight values (in the range 0 to 1) to the vertices within a vertex group. Hence vertex groups are sometimes also named ‘weight groups’.

Usage

Vertex groups are most commonly used for armatures. But they are also used in many other areas of Blender, like for example:

- Armature deformation *(also called skinning)*
- Shape keys
- Modifiers
- Particle generators
- Physics simulations

See also

Skinning Mesh Objects.

Many more usage scenarios are possible. Actually you can use vertex groups for whatever makes sense to you. In some contexts vertex groups can also be automatically generated (e.g. for rigged objects). However, in this section we will focus on manually created (user-defined) vertex groups.

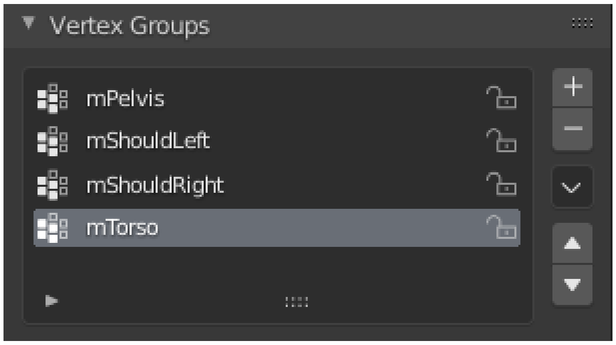
Note

Vertex groups only apply to mesh and lattice objects.

Vertex Groups Panel

Reference

Mode:: All Modes
Panel:: *Object Data tab ‣ Vertex Groups*


Vertex Groups
mPelvis
mShouldLeft
mShouldRight
mTorso

The Vertex Group panel.

Vertex groups are maintained within the *Object Data* Properties, in the *Vertex Groups* panel.

Active Vertex Group

- A List view.

  Lock

  - Locks the group from being editable. You can only rename or delete the group.

  Add +

  - Create an empty vertex group.

  Remove –

  - Deletes the active vertex group.

  Specials

  - Sort by Name
    - Sorts vertex groups alphabetically.
  - Sort by Bone Hierarchy
    - (Todo)
  - Duplicate Vertex Group

Add a copy of the active vertex group as a new group. The new group will be named like the original group with “_copy” appended at the end of its name. And it will contain associations to exactly the same vertices with the exact same weights as in the source vertex group.

Copy Vertex Group to Selected

Copy all vertex groups to other selected objects provided they have matching indices (typically this is true for copies of the mesh which are only deformed and not otherwise edited).

Mirror Vertex Group

Mirrors weights and/or flips group names. See Mirror Vertex Group for more information.

Mirror Vertex Group (Topology)

Performs the *Mirror Vertex Group* with the *Topology Mirror* option enabled.

Remove from All Groups

Unassigns the selected vertices from all (even locked) groups. After this operation has been performed, the vertices will no longer be contained in any vertex group. (Not available for locked groups.)

Clear Active Group

Remove all assigned vertices from the active group. The group is made empty. Note that the vertices may still be assigned to other vertex groups of the object. (Not available for locked groups.)

Delete All Unlocked Groups

Remove all vertex groups from the object that are *not* locked.

Delete All Groups

Remove all vertex groups from the object.

Lock All

Lock all groups.

Unlock All
    Unlock all groups.

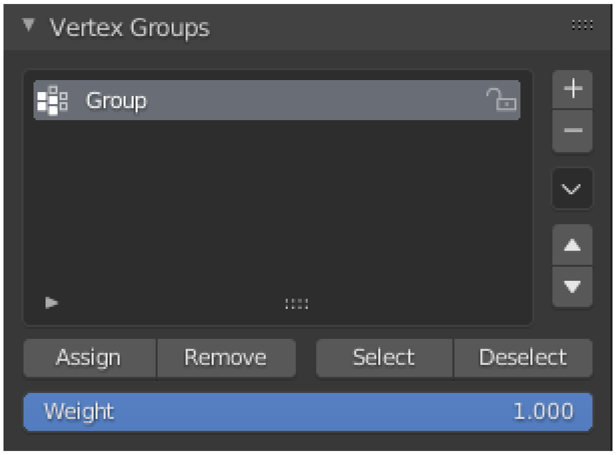
Lock Invert All
    Invert group locks.

Editing Vertex Groups

Reference

Mode::	Edit Mode
Panel::	*Object Data tab* ▸ *Vertex Groups*
Menu::	*Vertex* ▸ *Vertex Groups*
Shortcut::	`Ctrl-G`

When you switch either to Edit Mode or to Weight Paint Mode, vertex weights can be edited. The same operations are available in the 3D Viewport's *Vertex* ▸ *Vertex Groups* menu or `Ctrl-G`.



Vertex Group panel in Edit or Weight Paint Mode.

Assign
    To assign the selected vertices to the active group with the weight as defined in the *Weight* (see below).

Remove
    To remove the selected vertices from the active group (and thus also delete their weight values).

Select
To select all vertices contained in the group.

Deselect
To deselect all vertices contained in the group.

Weight
The weight value that gets assigned to the selected vertices.

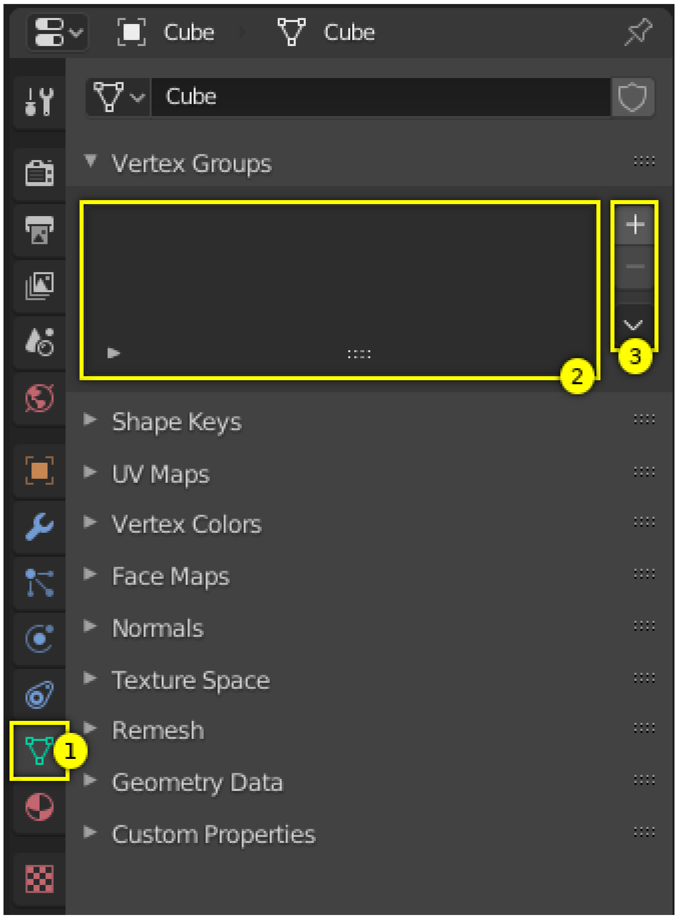
Set Active Group
Lets you select the group that will become the active one (menu only).

Assigning a Vertex Group

Creating Vertex Groups

Vertex groups are maintained within the *Object Data* tab (1) in the Properties. As long as no vertex groups are defined (the default for new mesh objects), the panel is empty (2).

You create a vertex group by `LMB` on the *Add* button + on the right panel border (3). Initially the group is named “Group” (or “Group.nnn” when the name already exists) and gets displayed in the panel (2) (see next image).


Cube
Cube
Cube
Vertex Groups
1
2
3
Shape Keys
UV Maps
Vertex Colors
Face Maps
Normals
Texture Space
Remesh
Geometry Data
Custom Properties

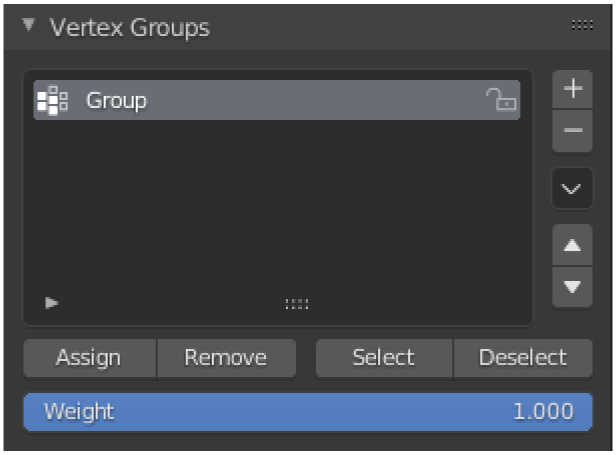
Empty Vertex Groups panel.

Vertex Groups Panel Controls

Once a new vertex group has been added, the new group appears in the Vertex Groups panel. There you find three clickable elements:

Group Name

The group name can be changed by double-clicking `LMB` on the name itself. Then you can edit the name as you like.



One vertex group.

Filter (arrow icon)

When the little arrow icon in the left lower corner is clicked, a new row opens up where you can enter a search term. This becomes handy when the number of vertex groups gets big.

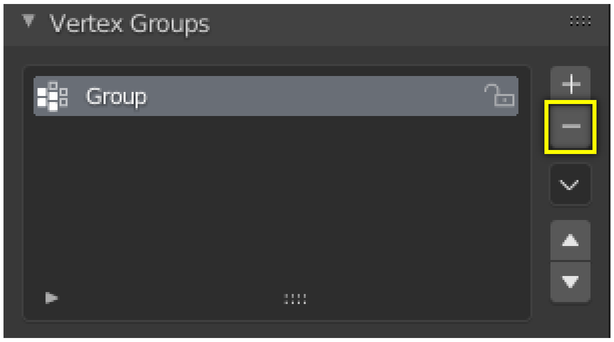
Drag Handle

If you have a large number of vertex groups and you want to see more than a few groups, you can `LMB` on the small drag handle to make the vertex groups list larger or smaller.

Active Group

When a vertex group is created, then it is also automatically marked as the *Active Group*. This is indicated by setting the background of the panel entry to a light gray color. If you have two or more groups in the list, then you can change the active group by `LMB` on the corresponding entry in the Vertex Groups panel.

Deleting Vertex Groups



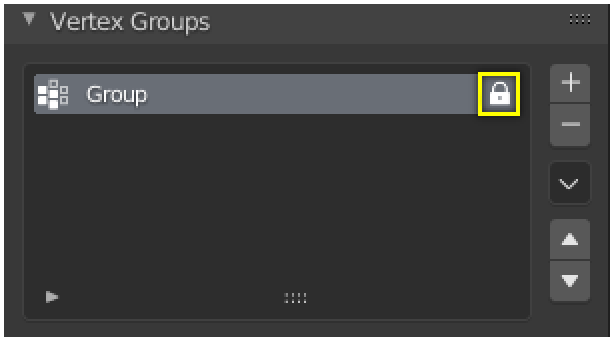
You delete a vertex group by first making it the active group (select it in the panel) and then `LMB` the *Remove* button – at the right panel border.

Deleting a vertex group only deletes the vertex assignments to the group. The vertices themselves are not deleted.

Delete a vertex group.

Locking Vertex Groups

Right after creation of a vertex group, an open padlock icon shows up on the right side of the list entry. This icon indicates that the vertex group can be edited. You can add vertex assignments to the group or remove assignments from the group. And you can change it with the weight paint brushes, etc.


Vertex Groups
Group

Lock a vertex group.

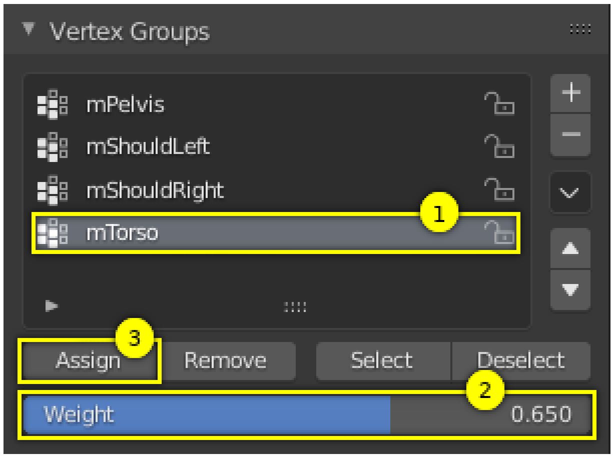
When you click on the icon, it changes to a closed padlock icon and all vertex group modifications get disabled. You can only rename or delete the group, and unlock it again. No other operations are allowed on locked vertex groups, thus all corresponding buttons become disabled for locked vertex groups.

Working with Content of Vertex Groups

Assigning Vertices to a Group

You add vertices to a group as follows:

- Select the group from the group list, thus making it the active group (1).
- From the 3D Viewport select `Shift-LMB` all vertices that you want to add to the group.


Vertex Groups
mPelvis
mShouldLeft
mShouldRight
mTorso
1
3
Assign
Remove
Select
Deselect
2
Weight
0.650

- Set the weight value that shall be assigned to all selected vertices (2).
- `LMB` the *Assign* button to assign the selected vertices to the active group using the given weight (3).

Assign weights to active group.

Note that weight assignment is not available for locked vertex groups. The *Assign* button is grayed out in that case.

Note

Assign is additive

The *Assign* button only adds the currently selected vertices to the active group. Vertices already assigned to the group are not removed from the group.

Also keep in mind that a vertex can be assigned to multiple groups.

Checking Assignments

To be sure the selected vertices are in the desired vertex group, you can try press the deselect button. If the vertices remain selected then they are not yet in the current vertex group.

At this point you may assign them, but take care since all selected vertices will have their weight set to the value in the *Weight* field.

Removing Assignments from a Group

You remove vertices from a group as follows:

- Select the group from the group list (make it the active group).
- Select all vertices that you want to remove from the group.
- `LMB` click the *Remove* button.

Note that removing weight assignments is not available for locked vertex groups. The *Remove* button is grayed out in that case.

Using Groups for Selecting/Deselecting

You can quickly select all assigned vertices of a group:

- (Optionally) press `Alt-A` to deselect all vertices.
- Select the group from the group list (make it the active group).
- When you now `LMB` click the *Select* button, then the vertices assigned to the active group will be selected and highlighted in the 3D Viewport.
- When you `LMB` click the *Deselect* button instead, then the vertices assigned to the active group will be deselected in the 3D Viewport.

Note

Selecting/Deselecting is additive

If you already have vertices selected in the 3D Viewport, then selecting the vertices of a group will add the vertices but also keep the already selected vertices selected. Vice versa, deselecting the vertices of a vertex group will only deselect the vertices assigned to the group and keep all other vertices selected.

Finding Ungrouped Vertices

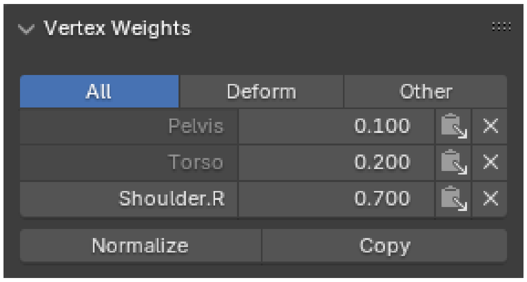
You can find ungrouped vertices as follows:

- Press `Alt-A` to deselect all vertices.
- In the header of the 3D Viewport, navigate to *Select ‣ Select All by Trait ‣ Ungrouped Vertices*.

Vertex Weights

Reference

Mode:: Edit and Weight Paint Modes
Panel:: *Sidebar region ▸ Vertex Weights*



Pelvis 0.100
Torso 0.200
Shoulder.R 0.700

Vertex Weights panel.

A vertex group assigns a weight (a number between 0 and 1) to each vertex it contains. A group can have multiple vertices, and each vertex can be part of multiple groups.

The *Vertex Weights* panel in the 3D Viewport's Sidebar shows the vertex groups for the active vertex, and lets you see and edit the associated weights. It's available in Edit Mode, as well as in Weight Paint Mode when Vertex Selection is enabled in the header.

Vertex Group Categories

While all vertex groups are technically the same, we can still divide them into two types depending on how they're used:

Deform Groups

Also sometimes called "weight group" or "weight map," this type of vertex group determines which vertices are affected by a certain bone in the Armature. In other words, it defines which part of the mesh deforms when the bone moves around.

Other Groups

The remaining vertex groups are used with shape keys, modifiers, and other areas.

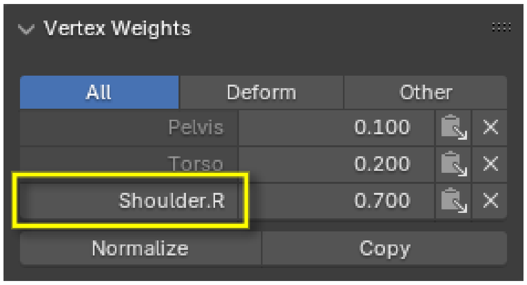
The deform vertex groups are related to each other: the deformation weights of every vertex typically need to add up to 1. For this reason, you can use the filter buttons at the top of the panel to show only these vertex groups (or to exclude them).

Weight Table

The Weight Table shows all the weights associated with the *active vertex*, which is the vertex that was selected last (and is highlighted in white). If there is no active vertex, or it isn't part of any vertex group, the panel is not displayed.

Set the Active Group

You can click the name of a vertex group to make it the active one.

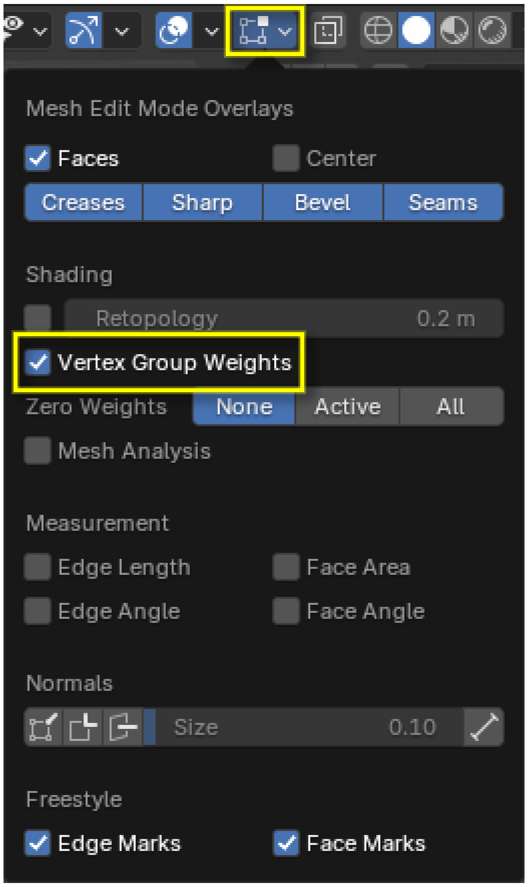


Pelvis	0.100
Torso	0.200
Shoulder.R	0.700

Changing the active vertex group.

Display Weights in Edit Mode

When you are in Edit Mode, you can make the weights of the active group visible on the mesh: open the *Mesh Edit Mode Overlays* popover and enable the *Vertex Group Weights* option.



Mesh Edit Mode Overlays

☑ Faces ☐ Center

Creases Sharp Bevel Seams

Shading

☐ Retopology 0.2 m

☑ Vertex Group Weights

Zero Weights None Active All

☐ Mesh Analysis

Measurement

☐ Edge Length ☐ Face Area

☐ Edge Angle ☐ Face Angle

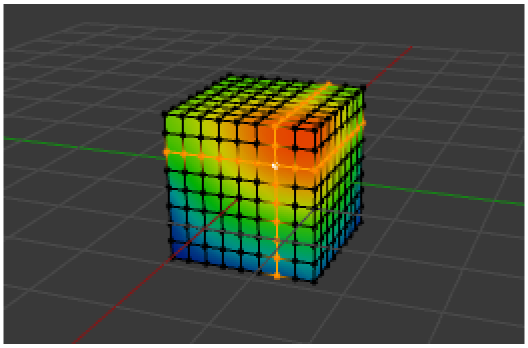
Normals

Size 0.10

Freestyle

☑ Edge Marks ☑ Face Marks

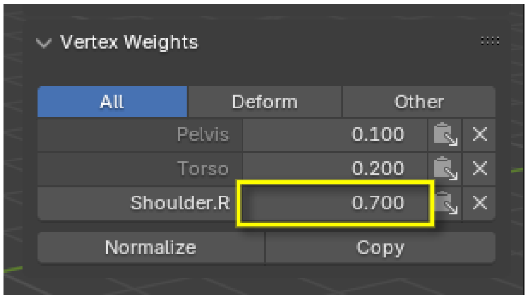
Enable display of weights in Edit Mode.



Weights in Edit Mode.

Change a Weight

You can change the weight for a vertex group by either clicking the number and typing a new one or by dragging left and right with `LMB`. You can also click the arrows (only shown when hovering) to change the weight in steps of 0.01.

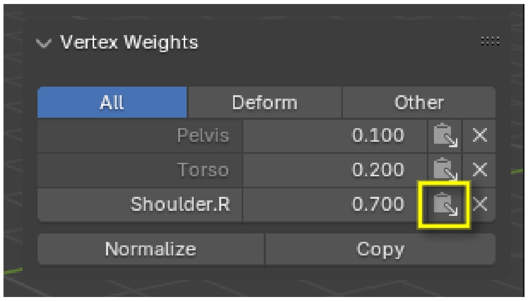

Vertex Weights
All
Deform
Other
Normalize
Copy

Pelvis 0.100
Torso 0.200
Shoulder.R 0.700

Changing a weight value.

Copy a Weight

The *Paste Weight to Selected* button copies the weight from the active vertex to the other selected vertices. Note that, even though it uses the word “paste,” it doesn’t interact with the *Copy* button and in fact doesn’t use the clipboard at all.

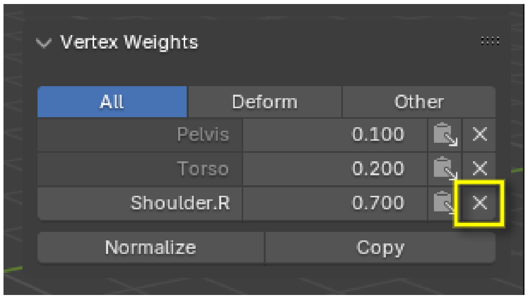

Vertex Weights
All
Deform
Other
Normalize
Copy

Pelvis 0.100
Torso 0.200
Shoulder.R 0.700

Copying a weight.

Delete a Weight

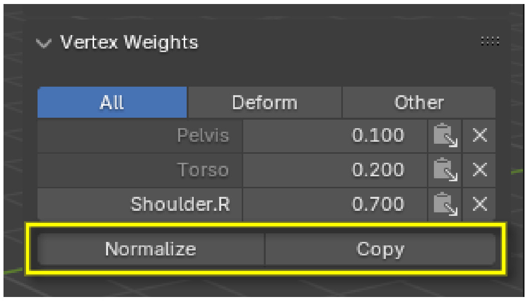
The *Delete Weight* button removes the active vertex from the vertex group, making the row disappear from the list.


Vertex Weights
All
Deform
Other
Normalize
Copy

Pelvis 0.100
Torso 0.200
Shoulder.R 0.700

Deleting a weight.

Operators


Vertex Weights
All
Deform
Other
Normalize
Copy

Pelvis 0.100
Torso 0.200
Shoulder.R 0.700

Vertex weight operators.

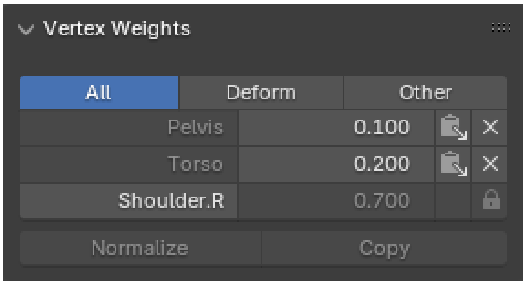
Normalize
: Recalculates the weights of the active vertex so that they add up to 1.0 while retaining their relative magnitude.

Copy
: Copies all the weights from the active vertex to the other selected vertices.

Tip

Both tools only work on the vertex groups that match the current filter setting.

Locking


Vertex Weights
All
Deform
Other
Normalize
Copy

Pelvis	0.100
Torso	0.200
Shoulder.R	0.700

Locked vertex group.

If a vertex group is locked, its weights become uneditable, and the buttons for copying and normalizing weights become disabled.

Tip

The *Normalize* and *Copy* buttons only become disabled if there’s a locked vertex group in the current list. If (for example) only non-deforming vertex groups are locked, you can switch to the *Deform* filter and normalize the groups that way.

Geometry Data

This panel is used to manage any generic data attributes that a mesh could have.

Warning

Clearing any data will result in the data loss of these values.

Clear Sculpt Mask Data

Deletes the internal `sculpt_mask` attribute. This attribute is used by the Sculpt Masking Feature.

Add/Clear Skin Data

Used to manage the skin data which is used by the Skin Modifier. This operator can be needed in case a Skin modifier is created but no skin data exist.

Add/Clear Custom Split Normals Data

Adds Custom Split Normals data, if none exists yet.

UVs

- UVs & Texture Space
    - UV Maps
    - Texture Space
- Unwrapping
    - Introduction
    - Seams
- Tools
    - Toolbar
    - Types
- Editing
    - Transform
    - Randomize
    - Mirror
    - Snap
    - Merge
    - Split
    - Unwrap
    - Pin & Unpin
    - Invert Pins
    - Mark/Clear Seams
    - Seams from Islands
    - Pack Islands
    - Average Island Scale
    - Minimize Stretch
    - Stitch
    - Align
    - Align Rotation
    - Copy UVs
    - Paste UVs
    - Show/Hide Faces
    - Export UV Layout
    - Proportional Editing
    - UV Options

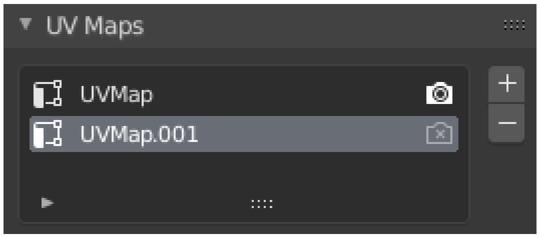
  - 3D Viewport
- Workflows
  - Layout Workflow
  - UDIMs
- Using UV Maps
  - Using the Test Grid

UVs & Texture Space

UV Maps

Reference

Mode::	All Modes
Panel::	*Properties* ▸ *Data* ▸ *UV Maps*



The UV Maps panel in the Data tab.

If you have a mesh object selected, you'll find its UV maps in the Data tab of the Properties editor. After selecting a map, you can view and edit it in the UV editor.

One mesh can have multiple UV maps (e.g. one map per texture), although it's also possible to reuse a UV map for multiple textures.

Active Render
: Click the camera icon to make a certain UV map the default one for rendering. This will be the map that's used by the *UV* output of the Texture Coordinate Node. You can use the UV Map Node to access any other maps.

Add +
: Duplicates the selected UV map, or creates a new one if the list is empty.

Remove –

Removes the selected UV map.

Texture Space

Reference

Mode:: All Modes
Panel:: *Properties ‣ Data ‣ Texture Space*

This panel lets you configure the object's Texture Space, which is a 3D box used for generating texture coordinates without the use of a UV map. You can visualize the texture space using the option in the Viewport Display panel.

Auto Texture Space

Calculates the texture space automatically.

Location, Size

Lets you define the texture space manually, relative to the object. Note that you can also edit it in the 3D Viewport – see Editing below.

Texture Mesh *Mesh objects*

Use another mesh for texture indices. The vertices of the two objects must be perfectly aligned or the UV map will be distorted.

Match Texture Space *Curve objects*

Modifies the *Location* and *Size* to match the object's bounding box. This disables Auto Texture Space.

Editing

Reference

Mode:: Object Mode and Edit Mode

Menu:: *Object ‣ Transform ‣ Move/Scale Texture Space*

Click one of these menu items, then move the mouse to adjust the texture space and press `LMB` to confirm. While transforming, you can use keyboard shortcuts to lock certain axes; see the status bar.

Accessing

When setting up a material shader, you can use the *Generated* output of the Texture Coordinate Node to read the 3D coordinate inside the object's texture space. You can then pass this coordinate to a texture node.

Tip

Texture spaces do not have rotation support. You can use a Mapping Node to manually rotate the coordinate in the material shader instead.

Unwrapping

- Introduction
    - About UVs
    - Getting Started
- Seams
    - Mark Seam

Introduction

The first step is to unwrap your mesh. Generally, it is recommended to start unwrapping when only minor adjustments to the geometry of your model are required. If you do add faces or subdivide existing faces when a model is already unwrapped, Blender will add those new faces for you, but you may need to do additional mapping or editing. In this fashion, you can use the UV texture image to guide additional geometry changes.

About UVs

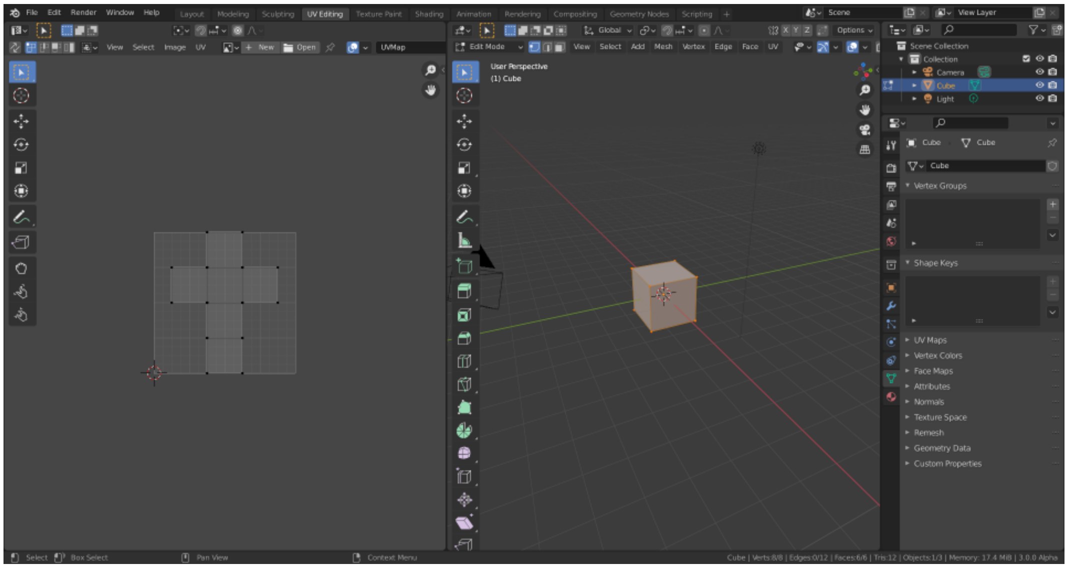
Every point in the UV map corresponds to a vertex in the mesh. The lines joining the UVs correspond to edges in the mesh. Each face in the UV map corresponds to a mesh face. Think of a UV map as projecting the surface of your 3D model onto a 2D image.

Each face of a mesh can have many UV textures. Each UV texture can have an individual image assigned to it. When you unwrap a face to a UV texture in the UV Editor, each face of the mesh is automatically assigned four UV coordinates: These coordinates define the way an image or a texture is mapped onto the face. To distinguish from XYZ coordinates, the U and V axes are used to mark the coordinates of each point. Hence the name, UV unwrapping. These coordinates can be used for rendering or for real-time viewport display as well.

Every face in Blender can have a link to a different image. The UV coordinates define how this image is mapped onto the face. This image then can be rendered or displayed in real-time. A 3D Viewport has to be in “Face Select” mode to be able to assign Images or change UV coordinates of the active mesh object. This allows a face to participate in many UV textures. A face at the hairline of a character might participate in the facial UV texture, *and* in the scalp/hair UV texture.

These are described more fully in the next sections.

Getting Started



Default UV editing workspace.

By default, meshes are not created with UVs. First you must map the faces, then you can edit them. The process of unwrapping your model is done within Edit Mode in the 3D Viewport. This process creates one or more UV Islands in the UV Editor.

To begin, choose the *UV Editing* workspace from the selection list at the top of your screen in the Preferences header. This sets one of the areas to show you the UV Editor, and the other area to the 3D Viewport.

Enter *Edit Mode*, as all unwrapping is done in Edit Mode. You can be in vertex, face, or edge selection mode.

Workflow

The general workflow is as follows, but know that different models may require different approaches to unwrapping:

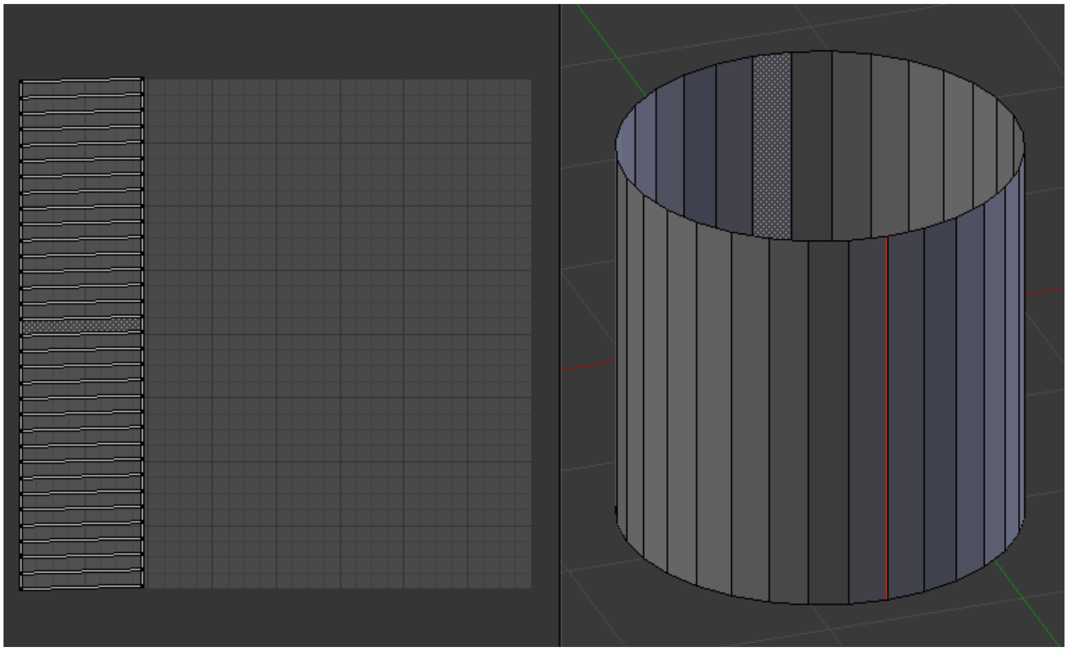
1. Mark Seams if necessary. See more about marking seams.
2. Select mesh faces in the 3D Viewport.

3. Select a UV mapping method from the *UV ▸ Unwrap* menu or the UV menu in the 3D Viewport.
4. Adjust the unwrap settings in the Adjust Last Operation panel.
5. Add a test image to see if there will be any distortion. See Applying Images to UVs.
6. Adjust UVs in the UV editor. See Editing UVs.

Seams

For many cases, using the Unwrap calculations of Cube, Cylinder, Sphere, or the regular "Unwrap" operators will produce a good UV layout. But for more complex meshes, especially those with lots of indentations, you may want to define a *seam* to limit and guide the Unwrap operator.

Just like in sewing, a seam is where the ends of the image/cloth are sewn together. In unwrapping, the UV map is discontinuous at the seams. Think of this method as peeling an orange or skinning an animal. You make a series of cuts in the skin, then peel it off. You could then flatten it out, applying some amount of stretching. These cuts are the same as seams.



Simple seam on a cylinder.

When using this method, you need to be aware of how much stretching there is. The more seams there are, the less stretching there is, but this is often an issue for the texturing process. It is a good idea to have as few seams as possible while having the least amount of stretching. Try to hide seams where they will not be seen. In productions where 3D paint is used, this becomes less of an issue, as projection painting can easily deal with seams, as opposed to 2D texturing, where it is difficult to match the edges of different UV islands.

The workflow is the following:

1. Mark seams.
2. Unwrap.
3. Adjust seams and repeat.
4. Manually adjust UVs.

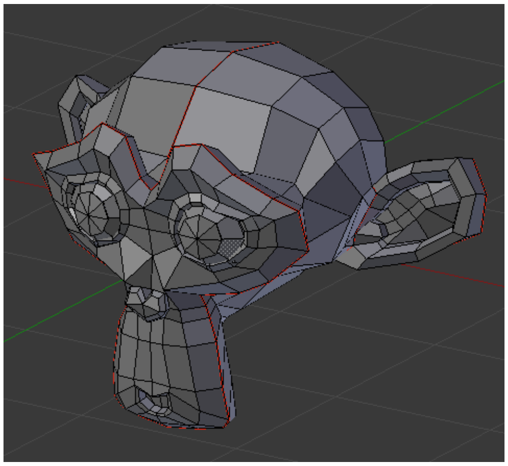
Mark Seam

Reference

Editor:: 3D Viewport
Mode:: Edit Mode
Tool:: *UV ▸ Mark/Clear Seam*
Menu:: *Edge ▸ Mark/Clear Seam*

Reference

Editor:: UV Editor
Mode:: View mode
Menu:: *UV ▸ Mark/Clear Seam*



Seamed Suzanne.

To add an edge to a seam, simply select the edge and press `Ctrl-E` to *Mark Seam*, or to remove it, use `Ctrl-E` to *Clear Seam*.

In the example to the right, the back-most edge of the cylinder was selected as the seam (to hide the seam), and the default unwrap calculation was used. In the UV Editor, you can see that all the faces are nicely unwrapped, just as if you cut the seam with a scissors and spread out the fabric.

When marking seams, you can use Select Linked in Face Select Mode to check your work. This menu option selects all faces connected to the selected one, up to a seam. If faces outside your intended seam are selected, you know that your seam is not continuous. You do not need continuous seams, however, as long as they resolve regions that may stretch.

Just as there are many ways to skin a cat, there are many ways to go about deciding where seams should go. In general though, you should think as if you were holding the object in one hand, and a pair of sharp scissors in the other, and you want to cut it apart and spread it on the table with as little tearing as possible. Note that we seamed the outside edges of her ears, to separate the front from the back. Her eyes are disconnected sub-meshes, so they are automatically unwrapped by themselves. A seam runs along the back of her head vertically, so that each side of her head is flattened out.

Another use for seams is to limit the faces unwrapped. For example, when texturing a head, you do not really need to texture the scalp on the top and back of the head since it will be covered in hair. So define a seam at the hairline. Then, when you select a frontal face, and then select linked faces before unwrapping, the select will only go up to the hairline seam, and the scalp will not be unwrapped.

When unwrapping anything that is bilateral, like a head or a body, seam it along the mirror axis. For example, cleave a head or a whole body right down the middle in front view. When you unwrap, you will be able to overlay both halves onto the same Texture Space, so that the image pixels for the right hand will be shared with the left; the right side of the face will match the left, etc.

Note

You **do not** have to come up with “one unwrapping that works perfectly for everything everywhere”. As we will discuss later, you can easily have multiple UV unwrappings, using different approaches in different areas of your mesh.

Seams from Islands

Reference

Mode:: View mode
Menu:: *UV ‣ Seams from Islands*

Adds seams at the boundaries of existing UV islands. This is useful when modifying the UVs of already unwrapped meshes.

Tools

- Toolbar

Types

- Rip
- Grab
- Relax
- Pinch

Toolbar

Select
: Select or moved.

  Select Box
  : Select UVs by dragging a box.

  Select Circle
  : Select UVs by painting on it.

  Select Lasso
  : Select UVs by drawing a lasso.

Cursor
: Change the location of the 2D Cursor.

Move
: Translation tool.

Rotate
: Rotation tool.

Scale
: Scale tool.

Transform
: Tool to adjust the UVs translation, rotation and scale.

Annotate
: Draw free-hand annotation.

  Annotate Line
  : Draw straight line annotation.

Annotate Polygon
: Draw a polygon annotation.

Annotate Eraser
: Erase previous drawn annotations.

Rip
: The Rip tool separates UV faces from each other.

Grab
: The Grab tool moves UVs around using a brush.

Relax
: The Relax tool makes UVs more evenly distributed using a brush.

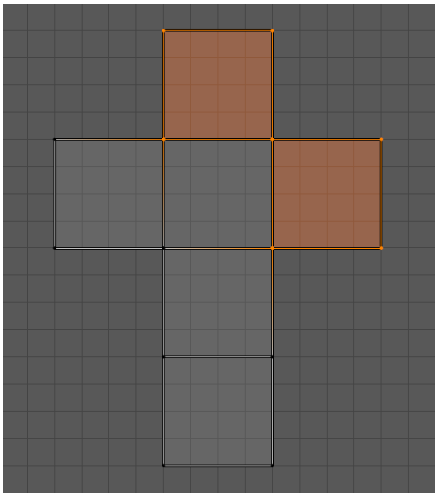
Pinch
: The Pinch tool moves UVs toward the brush’s center.

Rip

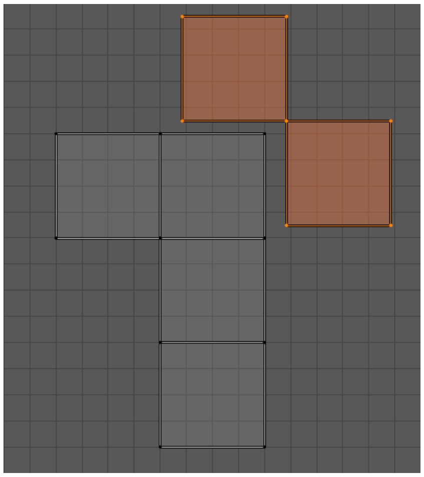
Reference

Mode::	Edit Mode
Tool::	*Toolbar* ‣ *Rip*
Shortcut::	V

The Rip tool separates UV components (vertices, edges, faces) from connected components. The components are ripped in the direction of the mouse pointer position.



Before.



After.

See also

Mesh editing Rip operation.

Grab

Reference

Mode:: Edit Mode
Tool:: *Toolbar ‣ Grab*

The Grab tool moves UVs around.

Tool Settings

Size

This option controls the radius of the brush, measured in pixels. `F` allows you to change the brush size interactively by dragging the mouse and then `LMB`. Typing a number then enter while using `F` allows you to enter the size numerically.

Strength

Controls how much each application of the brush affects the UVs. You can change the brush strength interactively by pressing `Shift-F` in the 3D Viewport and then moving the brush and then `LMB`. You can enter the size numerically also while in `Shift-F` sizing.

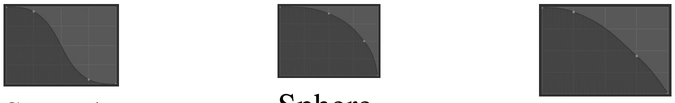
Falloff

The Falloff allows you to control the *Strength* falloff of the brush. The falloff is mapped from the center of the brush (left part of the curve) towards its borders (right part of the curve). Changing the shape of the curve will make the brush softer or harder. Read more about using the Curve Widget.

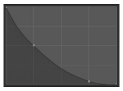
Curve Preset

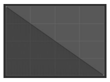
Custom:: You can choose how the strength of the falloff is determined from the center of the brush to the borders by manually manipulating the control points within the curve widget. There are also a couple of preset custom curves displayed at the bottom of the curve widget that can be used on their own or as a starting point for tweaking.

Custom Preset types.



Smooth. Sphere. Root.


Sharp.


Linear.

Constant.

Smooth::	The center strength, the border strength, and the falloff transition between them are evenly distributed.
Smoother::	Similar to *Smooth* but produces a wider center point of the brush before tapering off.
Sphere::	The strength of the brush is predominately at its strongest point with a steep falloff near the border of the brush.
Root::	Similar to a Sphere but the center is a more concentrated point.
Sharp::	The center of the brush is the strongest point then exponentially tapers off to a lower strength, creating a fine point.
Linear::	With the center being the strongest, the strength will consistently weaken as it reaches the border of the brush.
Sharper::	Similar to *Sharp* but the center point is more condensed.
Inverse Square::	A hybrid between *Smooth* and *Sphere*.
Constant::	The strength of the brush remains unified across the entire brush. This will create a sharp edge at the border of the brush.

Options

Lock Borders

Locks the boundary of UV islands from being affected by the brush. This is useful to preserve the shape of UV islands.

Sculpt All Islands

To edit all islands and not only the island nearest to the brush center when the sculpt stroke was started.

Relax

Reference

Mode:: Edit Mode

Tool:: *Toolbar ‣ Relax*

The Relax tool can be used to distribute UVs more evenly. It works by pulling vertices along UV edges to bring the UV unwrap into balance.

The Relax tool can be compared with the Minimize Stretch tool which works directly on faces to reduce texture stretching and shearing. You may find that sometimes minimize stretch works better, sometimes the unwrap tool and other times the Relax tool.

First using Unwrap, then Minimize Stretch and touching up with the Relax tool often gives the best results. Remember, you can use "Undo" at any time to return to an earlier state.

Tool Settings

Size

This option controls the radius of the brush, measured in pixels. `F` allows you to change the brush size interactively by dragging the mouse and then `LMB`. Typing a number then enter while using `F` allows you to enter the size numerically.

Strength

Controls how much each application of the brush affects the UVs. You can change the strength interactively by pressing `Shift-F` in the 3D Viewport and then moving the brush and then `LMB`. You can enter the size numerically also while in `Shift-F` sizing.

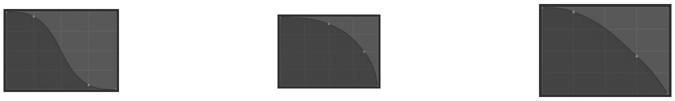
Falloff

The Falloff allows you to control the *Strength* falloff of the brush. The falloff is mapped from the center of the brush (left part of the curve) towards its borders (right part of the curve). Changing the shape of the curve will make the brush softer or harder. Read more about using the Curve Widget.

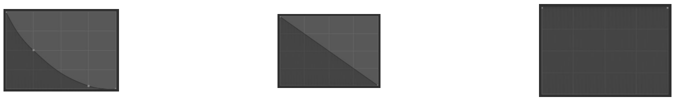
Curve Preset

Custom:: You can choose how the strength of the falloff is determined from the center of the brush to the borders by manually manipulating the control points within the curve widget. There are also a couple of preset custom curves displayed at the bottom of the curve widget that can be used on their own or as a starting point for tweaking.

Custom Preset types.



Smooth. Sphere. Root.



Sharp. Linear. Constant.

Smooth::	The center strength, the border strength, and the falloff transition between them are evenly distributed.
Smoother::	Similar to *Smooth* but produces a wider center point of the brush before tapering off.
Sphere::	The strength of the brush is predominately at its strongest point with a steep falloff near the border of the brush.
Root::	Similar to a Sphere but the center is a more concentrated point.
Sharp::	The center of the brush is the strongest point then exponentially tapers off to a lower strength, creating a fine point.
Linear::	With the center being the strongest, the strength will consistently weaken as it reaches the border of the brush.
Sharper::	Similar to *Sharp* but the center point is more condensed.
Inverse Square::	A hybrid between *Smooth* and *Sphere*.
Constant::	The strength of the brush remains unified across the entire brush. This will create a sharp edge at the border of the brush.

Options

Lock Borders

Locks the boundary of UV islands from being affected by the brush. This is useful to preserve the shape of UV islands.

Sculpt All Islands

To edit all islands and not only the island nearest to the brush center when the sculpt stroke was started.

Method

How to determine the edge weighting:

Laplacian::	The classic discrete laplace operator applied to the UV graph. Each edge has equal weighting, resulting in triangles which resemble a honeycomb shape, or quads aligned into square grid.
HC::	Similar to Laplacian, the HC method uses equal weighting while trying to preserve a gradient between dense regions of the mesh and regions with fewer edges. Note, this method uses the "Humphrey's Classes" operator as described in the paper: "Improved Laplacian Smoothing of Noisy Surface Meshes".
Geometry::	Edges are weighted according to the discrete Laplace operator (cotangent formula) applied to the 3D geometry. This tries to bring the relative lengths of edges in UV closer to the relative lengths of edges in 3D, resulting in a UV unwrap with less distortion across edge boundaries.

Pinch

Reference

Mode:: Edit Mode

Tool:: *Toolbar ‣ Pinch*

The Pinch tool moves UVs toward the brush's center. The pinch tool can be inverted by pressing `Ctrl-LMB`.

Tool Settings

Size

This option controls the radius of the brush, measured in pixels. `F` allows you to change the brush size interactively by dragging the mouse and then `LMB`. Typing a number then enter while using `F` allows you to enter the size numerically.

Strength

Controls how much each application of the brush affects the UVs. You can change the brush strength interactively by pressing `Shift-F` in the 3D Viewport and then moving the brush and then `LMB`. You can enter the size numerically also while in `Shift-F` sizing.

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Curve Preset

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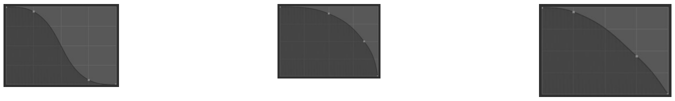
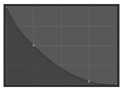
Custom Preset types.



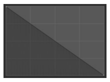
Smooth.

Sphere.

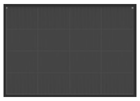
Root.



Sharp.



Linear.



Constant.

Smooth::	The center strength, the border strength, and the falloff transition between them are evenly distributed.
Smoother::	Similar to *Smooth* but produces a wider center point of the brush before tapering off.
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Sharper::	Similar to *Sharp* but the center point is more condensed.
Inverse Square::	A hybrid between *Smooth* and *Sphere*.
Constant::	The strength of the brush remains unified across the entire brush. This will create a sharp edge at the border of the brush.

Options

Lock Borders

Locks the boundary of UV islands from being affected by the brush. This is useful to preserve the shape of UV islands.

Sculpt All Islands

To edit all islands and not only the island nearest to the brush center when the sculpt stroke was started.

Editing

After unwrap, you will likely need to arrange the UV maps, so that they can be used in texturing or painting. Your goals for editing are:

- Stitch pieces (of UV maps) back together.
- Minimize wasted space in the image.
- Enlarge the faces where you want more detail.
- Re-size/enlarge the faces that are stretched.
- Shrink the faces that are too grainy and have too much detail.

With a minimum of dead space, the most pixels can be dedicated to giving the maximum detail and fineness to the UV texture. A UV face can be as small as a pixel (the little dots that make up an image) or as large as an entire image. You probably want to make major adjustments first, and then tweak the layout.

Transform

Reference

Editor::	UV Editor
Mode::	Edit Mode
Tool::	*Toolbar ‣ Move, Rotate, Scale, Transform*
Menu::	*UV ‣ Transform*

- Move `G`
- Rotate `R`
- Scale `S`
- Shear `Shift-Ctrl-Alt-S`

Axis Locking

Transformations can be locked to an axis by pressing `X` or `Y` after one of the transform tools. Also, holding the `MMB` will constrain movement to the X or Y axis.

Vertex Slide

Reference

Mode:: Edit Mode
Menu:: *UV ‣ Transform ‣ Vertex Slide*

Vertex Slide will transform a vertex along one of its adjacent edges. Use `Shift-V` to activate tool. The nearest selected vertex to the mouse cursor will be the control one. Move the mouse along the direction of the desired edge to specify the vertex position. Then press `LMB` to confirm the transformation.

Factor
  Determines the amount of slide performed. Negative values correspond to slides toward one vertex, while positive ones, refer to the other one.

Even `E`
  By default, the offset value of the vertices is a percentage of the edges length along which they move. When Even mode is active, the vertices are shifted by an absolute value.

Flipped `F`
  When Flipped is active, vertices move the same distance from adjacent vertices, instead of moving from their original position.

Clamp `Alt` or `C`
  Toggle clamping the slide within the edge extents.

Edge Slide

Reference

Mode:: Edit Mode
Menu:: *UV ‣ Transform ‣ Edge Slide*

Slides one or more edges across adjacent faces with a few restrictions involving the selection of edges (i.e. the selection *must* define a valid loop, see below).

Factor
: Determines the amount of slide performed. Negative values correspond to slides toward one face, while positive ones, refer to the other one.

Even `E`
: Forces the edge loop to match the shape of the adjacent edge loop. You can flip to the opposite vertex using `F`.

Flipped `F`
: When Even mode is active, this flips between the two adjacent edge loops the active edge loop will match.

Clamp `Alt` or `C`
: Toggle clamping the slide within the edge extents.

Mirror Editing
: Lets you propagate the operation to the symmetrical elements of the mesh (if present, in local X direction).

Randomize

Reference

Editor:: UV Editor
Mode:: Edit Mode
Menu:: *UV ‣ Transform ‣ Randomize*

Randomize the scale, rotation and offset of selected UV islands. The *Randomize Transform* tool in the UV editor works similar to *Randomize Transform* tool in the 3d view.

Random Seed
Changes the random seed used by the pseudo-random number generator, producing a different transform result for each seed value.

Location
Amount to randomize location.

Rotation
Amount to randomize rotation.

Scale Even
Apply the same scale to the U coordinate and V coordinate.

Scale
Amount to randomize scale in U and V coordinates.

Mirror

Reference

Editor::	UV Editor
Mode::	Edit Mode
Menu::	*UV ▸ Mirror*
Shortcut::	`Ctrl-M`

UVs can be mirrored on the Y axis or the X axis:

- Mirror X
- Mirror Y

You can also use the hotkeys `X` or `Y`, or hold the `MMB` and drag in the mirror direction.

Copy Mirrored UV Coordinates

Reference

Editor:: UV Editor
Mode:: Edit Mode
Menu:: *UV ‣ Copy Mirrored UV Coordinates*

Copies UVs from one side of the mirrored mesh to the other. Affects only selected vertices (on both sides).

Axis Direction
: Positive/Negative

Precision
: Tolerance for finding vertex duplicates.

Snap

Reference

Editor:: UV Editor
Mode:: Edit Mode
Menu:: *UV ‣ Snap*
Shortcut:: `Shift-S`

Snapping in the UV Editor is similar to Snapping in 3D. For the snap to pixel options to work an image has to be loaded.

Selected to Pixels
: Moves selection to nearest pixel. See also *Round to Pixels* below.

Selected to Cursor
: Moves selection to 2D cursor location.

Selected to Cursor (Offset)
: Moves selection center to 2D cursor location, while preserving the offset of the vertices from the center.

Selected to Adjacent Unselected
: Moves selection to adjacent unselected element.

Cursor to Pixels
  Snaps the cursor to the nearest pixels.

Cursor to Selected
  Moves the Cursor to the center of the selection.

Cursor to Origin
  Places the cursor to the location (0, 0, 0).

Merge

Reference

Editor::	UV Editor
Mode::	Edit Mode
Menu::	*UV ▸ Merge*
Shortcut::	`M`

At Center
  Moves selected UVs to their average position.

At Cursor
  Moves selection UVs to 2D cursor location.

By Distance

Reference

Editor::	UV Editor
Mode::	Edit Mode
Menu::	*UV ▸ Merge ▸ By Distance*

Merges selected UVs within the specified *Merge Distance*.

Merge Distance
  Maximum distance between merged vertices.

Unselected

Merge selected to other unselected vertices.

Shared Vertex

Merge UVs that correspond to the same mesh vertex, even if they have different UV coordinates.

Split

Reference

Editor::	UV Editor
Mode::	Edit Mode
Menu::	*UV ▸ Split*
Shortcut::	`Alt-M`

Selection `Y`

Splits (disconnects) the selection from the rest of the UV. The border edge to any non-selected elements are duplicated.

Note that the “copy” is left exactly at the same position as the original, so you must move it to see it clearly.

Unwrap

Reference

Editor::	UV Editor
Mode::	Edit Mode
Menu::	*UV ▸ Unwrap*
Shortcut::	`U`

Blender offers several ways of mapping UVs. The simpler projection methods use formulas that map 3D space onto 2D space, by interpolating the position of points toward a point, axis or plane through a surface. The more advanced methods can be used with more complex models, and have more specific uses.

- Unwrap
- Smart UV Project
- Lightmap Pack
- Follow Active Quads
- Cube Projection
- Cylinder Projection
- Sphere Projection

Pin & Unpin

Reference

Editor::	UV Editor
Mode::	Edit Mode
Menu::	*UV ‣ Pin/Unpin*
Shortcut::	`P`, `Alt-P`

You can pin UVs so they do not move between multiple unwrap operations. When Unwrapping a model it is sometimes useful to “Lock” certain UVs, so that parts of a UV layout stay the same shape, and/or in the same place. Pinning is done by selecting a UV, then selecting *Pin* from the *UVs* menu, or the shortcut `P`. You can *Unpin a UV* with the shortcut `Alt-P`.

Pinning is most effective when using the Unwrap method of UV mapping, for organic objects. An example is when you are modeling a symmetrical object using the Mirror Modifier. Some of the UVs on the mirror axis may be shared across the mirrored counterparts. You could pin the UVs that correspond to the midline, then align them on the X axis, and they will stay in that location.

The sculpting tools, *Pinch* and *Relax*, will not move any pinned UVs. This allows you to pin the borders, or around interior holes, and gives even more control to the sculpt tools.

Pinning also works great with the *Live Unwrap* tool. If you pin two or more UVs, with *Live Unwrap* on, moving or scaling the pinned UVs will interactively unwrap the model. You can even use the *Grab* sculpting tool to move the pinned UVs. This helps with fitting a UV island to a certain shape or region.

Invert Pins

Reference

Editor:: UV Editor
Mode:: Edit Mode
Menu:: *UV ▸ Invert Pins*

Pin all un-pinned selected UVs and un-pin all currently selected pinned UVs.

Mark/Clear Seams

Reference

Editor:: UV Editor
Mode:: Edit Mode
Menu:: *UV ▸ Mark/Clear Seam*

See Seams.

Seams from Islands

Reference

Mode:: View mode
Menu:: *UV ▸ Seams from Islands*

Adds seams at the boundaries of existing UV islands. This is useful when modifying the UVs of already unwrapped meshes.

Pack Islands

Reference

Editor::	UV Editor
Mode::	Edit Mode
Menu::	*UV ‣ Pack Islands*

The *Pack Islands* tool can be used to optimize the UV layout by adjusting existing islands to efficiently fill the Texture Space. Based on the options selected, the tool will scale, translate and rotate the islands, ensuring a specified margin exists between them to maximize the usage of the UV space. Pinned islands can have additional restrictions applied to customize the packing process even further.

Shape Method

The method to use when considering the shape of each island.

Exact Shape (Concave)::	Use the complete shape of the island, including filling any holes or concave regions around the island.
Boundary Shape (Convex)::	Takes into account the boundary (Convex Hull) of the island. This method will not place islands inside holes.
Bounding Box::	Uses the simple bounding box of the island.

Scale

Scale the islands to fill the unit square, or pack islands towards the lower left corner.

Rotate

Allows the rotation of islands, as well as translation and scaling, to optimize texture usage.

Rotation Method

The allowable rotations to use for each each island.

Any::	Any rotation which improves the packing is allowed.
Axis-aligned::	The island will first be rotated into a smallest rectangle. Additional rotation will only be in 90-degree turns.
Cardinal::	Like the four cardinal directions on a compass, North, South, East and West, only 90-degree turns will be allowed.

Margin Method

The method to use when calculating the empty space between islands.

Scaled::	Use scale of existing UVs to multiply margin.
Add::	Simple method, just add the margin.
Fraction::	Precisely specify the fraction of the UV unit square for margin. (Slower than other two methods.)

Margin

The scale for the empty space between islands.

Lock Pinned Islands

An island which has any of its UVs pinned is considered a *Pinned Island*. With this option, *Pinned Islands* will be unable to move. The other islands will pack around them.

Lock Method

Change the way *Pinned Islands* are packed

Scale::	The scale of the *Pinned Islands* will not change.
Rotation::	*Pinned Islands* will not rotate.
Rotation and Scale::	

Pinned Islands can translate, but not scale nor rotate.

Merge Overlapping

Before the main packing operation, overlapping islands are detected and temporarily combined. During packing, the relative rotation and position of the merged islands are preserved.

Pack To

Determines the final placement of UV islands after completing the packing operation.

Closest UDIM::	Pack islands to the UDIM grid nearest to the center of the selection.
Active UDIM::	Pack islands to the active UDIM image tile or, if no image is available, the UDIM grid tile where the 2D cursor is located.
Original bounding box::	Find the original bounding box of the selection, packs the islands, and then moves them back inside the original box.

Note

The performance of the *Pack Islands* operator is heavily affected by the options selected, and sometimes the options can combine in different ways to produce unexpectedly slower results.

The fastest results can be obtained by using the “Bounding Box” shape method and the “Add” margin method.

Although enabling the “Rotate” option slightly impacts performance, it will often enhance efficiency, making it a good choice to always keep enabled.

However the “Fraction” margin method requires significantly more computation to find the exact scale. For certain layouts, it may even take up to 10 times longer to complete then using the simpler “Add” or “Scaled” methods.

Similarly, the “Exact shape” and “Boundary shape” methods are much slower than the simple “Bounding Box” method.

Average Island Scale

Reference

Editor::	UV Editor
Mode::	Edit Mode
Menu::	*UV ‣ Average Island Scale*

Using the *Average Island Scale* tool, will scale each UV island so that they are all approximately the same scale.

Non-Uniform
: Reduces average texture stretching within islands by scaling the U and V axes independently.

Shear
: Reduces average texture shearing within islands by shearing the U axis.

Minimize Stretch

Reference

Editor::	UV Editor
Mode::	Edit Mode
Menu::	*UV ‣ Minimize Stretch*

The *Minimize Stretch* tool, reduces UV stretch by minimizing the difference between the angles in 3D and the angles in UV space. This operation is similar to the Relax tool with the *Geometry* Relaxation Method, but uses a different algorithm.

Fill Holes

Just during *minimize stretch*, internal holes will be filled with temporary polygons to prevent stretching and overlaps of the surrounding UVs.

Blend

The fraction between 0 and 1 of the original UVs to blend in once the stretch is minimized. A blend of 0 is the fully minimized stretch. Blend of 0.5 is halfway between the original UVs and the minimize stretch UVs.

Iterations

More iterations result in smoother UVs, but take longer to process.

Stitch

Reference

Editor:: UV Editor
Mode:: Edit Mode
Menu:: *UV ▸ Stitch*
Shortcut:: `Alt-V`

The *Stitch* tool, will join selected UVs that share vertices. You set the tool to limit stitching by distance in the Adjust Last Operation panel, by activating *Use Limit* and adjusting the *Limit Distance*.

Align

Reference

Editor:: UV Editor
Mode:: Edit Mode
Menu:: *UV ▸ Align*
Shortcut:: `Shift-W`

Moves the selected UV vertices to a line, where that line is specified in different ways by *Axis*.

Axis

Straighten:: Positions UV vertices along the line defined by the endpoints.
Straighten X:: Positions UV vertices horizontally along the line defined by the endpoints.
Straighten Y:: Positions UV vertices vertically along the line defined by the endpoints.
Align Auto:: Positions UV vertices automatically chooses the direction based on which is most alignment already.
Align Vertically:: Positions UV vertices vertically along the line defined by the midpoint of the selection.
Align Horizontally:: Positions UV vertices horizontally along the line defined by the midpoint of the selection.

Align Rotation

Reference

Editor:: UV Editor
Mode:: Edit Mode
Menu:: *UV ‣ Align Rotation*

The *Align Rotation* tool aligns entire islands to either the U or V axis.

The tool has three different methods of operation. The different methods specify the source for the alignment, and also whether to align with both the U and V axes, or just the V axis alone.

When using the *Auto* method, islands are aligned so that UV edges are aligned to either the U axis or the V axis. This method works best with quads and meshes representing organic subjects.

When using the *Edge* method, only the selected edges are considered, and the islands will be aligned such that the selected edges are aligned with the V axis. This method works with the selection, so it works best when a particular edge, or edge loop, needs to be aligned in UV coordinates.

When using the *Geometry* method, the geometry is taken into consideration. Either the *X* axis, the *Y* axis, or the *Z* axis can be used. Suppose the *X* axis is chosen. Using this method, edges which have a positive extent in the *X* axis will be rotated in the UV map so that the edge extends upwards in the *V* axis. This method works best to align multiple islands which share some common geometric property, either in the X, Y or Z axis.

Note that in the *Auto* method, edges can end up aligned either up or down or left or right depending on the orientation of the island prior to activating the tool. In the *Edge* method, the alignment of selected edges can be either up or down in the V axis, whatever is closest to the current orientation of the UV island. By comparison, in the *Geometry* method, the alignment will always be pointing up in the V axis, ignoring any previous orientation.

Copy UVs

Reference

Editor::	UV Editor
Mode::	Edit Mode
Menu::	*UV ‣ Copy UVs*

For each selected UV island, the *Copy UVs* tool will copy it’s topology and UV coordinates into a temporary clipboard for later use with the *Paste UVs* tool.

Note

The *Copy UVs* tool currently uses an internal clipboard which is not shared between instances of blender.

Paste UVs

Reference

Editor::	UV Editor
Mode::	Edit Mode
Menu::	*UV ‣ Paste UVs*

For each selected UV island, the *Paste UVs* tool will attempt to match the topology of an island stored in the internal clipboard. If a match is found, the UVs stored in the clipboard for the original island will be pasted onto the currently selected island.

For example, if a triangle attached to a quad attached to a quad is in the clipboard, then a different triangle <=> quad <=> quad is selected, then the topologies match, and the UVs will be pasted over the current selection.

For best results, you may want to use the Rip tool, or *UV > Split > Selection*, prior to using *Paste UVs*.

Show/Hide Faces

Reference

Editor::	UV Editor
Mode::	Edit Mode
Menu::	*UV ‣ Show/Hide Faces*

- Reveal Hidden `Alt-H`
- Hide Selected `H`
- Hide Unselected `Shift-H`

Export UV Layout

Reference

Editor:: UV Editor
Mode:: Edit Mode
Menu:: *UV ▸ Export UV Layout*

If you are using an external application, you need to know where on the mesh you are painting.

Note

This is an add-on activated by default.

Proportional Editing

Reference

Editor:: UV Editor
Mode:: Edit Mode
Header:: *Proportional Editing*
Menu:: *UV ▸ Proportional Editing*
Shortcut:: O

Proportional Editing is available in UV editing. The controls are the same as in the 3D Viewport. See Proportional Editing in 3D for a full reference.

UV Options

Reference

Editor:: UV Editor
Mode:: Edit Mode
Menu:: *UVs*

Live Unwrap

Continuously unwraps the selected UV islands while transforming pinned vertices. Note, this is different than the Live Unwrap option in the 3D Viewport.

Round to Pixels

During UV transforms, you can use Round to Pixels to help with matching features in the image or ensure your UVs have precise horizontal, vertical or diagonal alignment.

Note that Round to Pixels is applied after any snapping modes.

Disabled::	UVs will not be rounded.
Corner::	Will force the UVs to round to the corner of the nearest pixel of an image if loaded.
Center::	Will force the UVs to round to the center of the nearest pixel of an image if loaded.

Constraining to Image Bounds

For standard textures, this option prevents UVs from being moved outside the 0 to 1 UV range. For UDIMs textures, this option prevents UVs from being moved outside the nearest UDIM tile.

3D Viewport

Rotate UVs

Reference

Editor::	3D Viewport
Mode::	Edit Mode
Menu::	*Face ▸ Face Data ▸ Rotate UVs*

The orientation of the UV texture is defined by each face. If the image is, for example, upside down or laying on its side, use the *Face ▸ Rotate UVs* (in the 3D Viewport in Face Select mode) menu to rotate the UVs per face in 90-degree turns.

Reverse UVs

Reference

Editor:: 3D Viewport
Mode:: Edit Mode
Menu:: *Face* ▸ *Face Data* ▸ *Reverse UVs*

The *Face* ▸ *Reverse UVs* tool mirrors the UVs per face, which flips the image over, showing you the image reversed.

Workflows

- Layout Workflow
    - Transferring UV Maps
    - Multiple UV Maps
    - Optimizing the UV Layout
    - Refining the Layout
- UDIMs
    - Workflow
    - File Substitution Tokens
    - UDIM Tiles

Layout Workflow

Transferring UV Maps

You can copy a UV map from one mesh to another mesh provided both meshes have the same geometry/vertex order. This is useful for example when you want to recreate a UV map from an earlier version of your model with intact UVs. This works by:

1. Select the target mesh (to which you want to copy the UV map).
2. `Shift` select the source mesh (that contains the intact UV map).
3. *Object menu* ‣ *Make Links…* ‣ *Transfer UV Layouts* (Shortcut: `Ctrl-L` …).

The target mesh will now have a UV map that matches the original mesh.

Multiple UV Maps

You are not limited to one UV map per mesh. You can have multiple UV maps for parts of the mesh by creating new UV maps. This can be done by clicking the *Add* button next to UV maps list and unwrapping a different part of the mesh. UV maps always include the whole mesh.

Optimizing the UV Layout

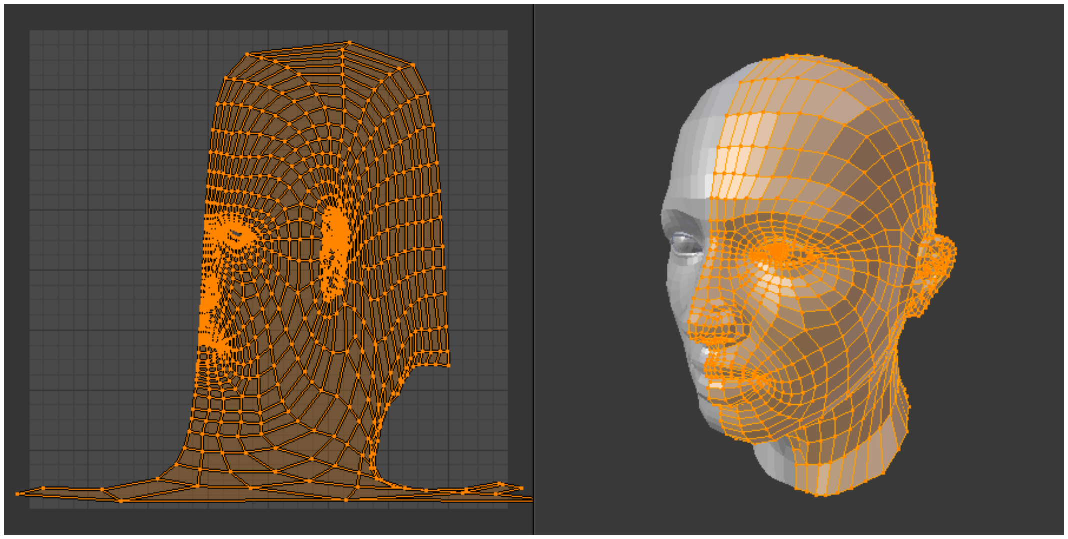
When you have unwrapped, possibly using seams, your UV layout may be quite disorganized and chaotic. You may need to proceed with the following tasks: Orientation of the UV mapping, arranging the UV maps, stitching several maps together.

The next step is to work with the UV layouts that you have created through the unwrap process. If you do add faces or subdivide existing faces when a model is already unwrapped, Blender will add those new faces for you. In this fashion, you can use the UV texture image to guide additional geometry changes.

When arranging, keep in mind that the entire view is your workspace, but only the UV coordinates within the grid are mapped to the image. So, you can put pieces off to the side while you arrange them. Also, each UV unwrap is its own linked set of coordinates.

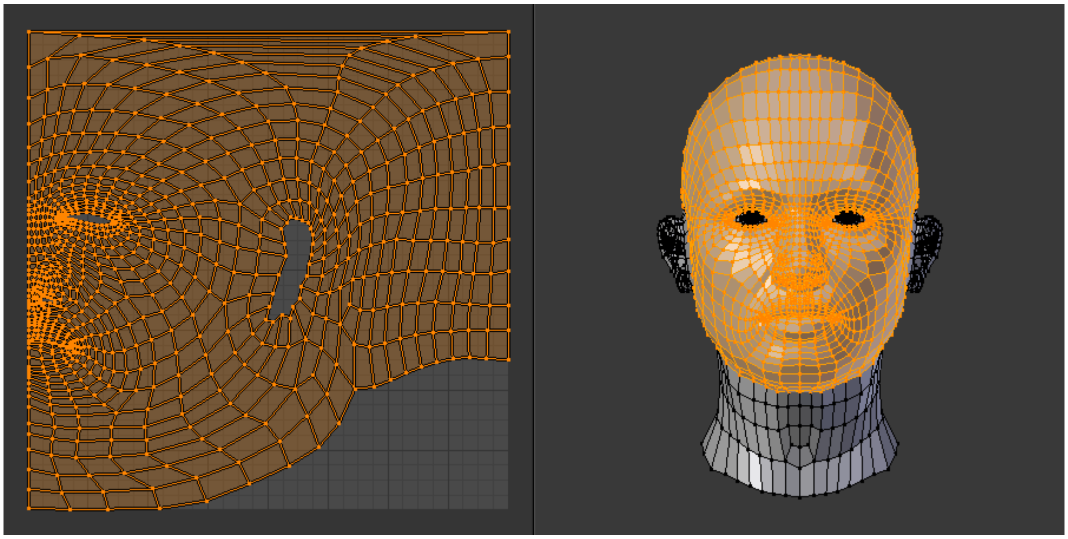
You can lay them on top of one another, and they will onion skin (the bottom one will show through the top one). To move only one though, `RMB` select one of the UV coordinates, and use *Select* ‣ *Linked UVs*, `Ctrl-L` to select connected UVs, not box select because UVs from both will be selected.

Combining UV Maps



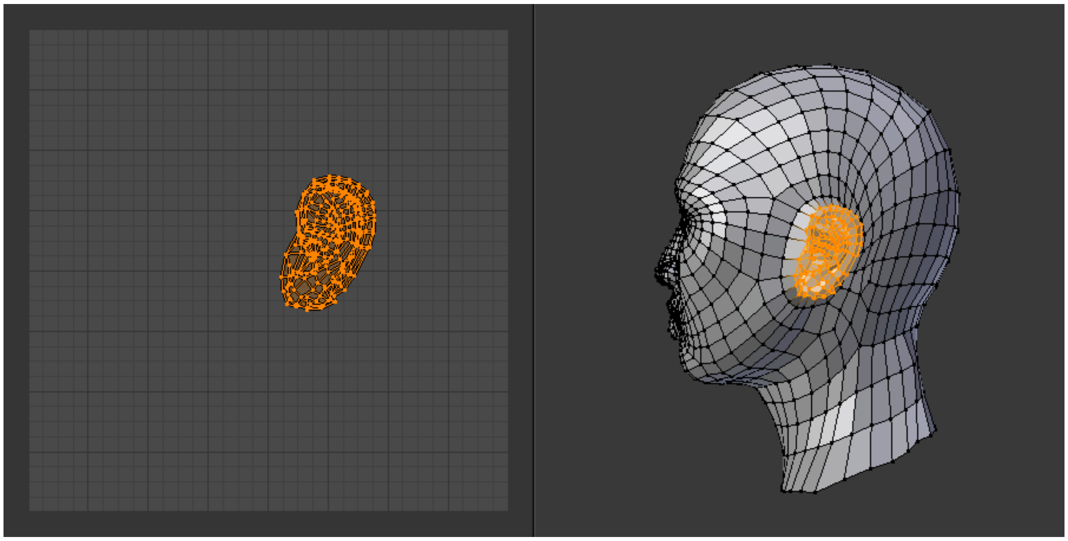
Bad unwrap, note ear and neck.

Very often you will unwrap an object, such as the face example we have been using, and get it "mostly right" but with parts of the mesh that did not unwrap properly, or are horribly confusing. The picture to the right shows an initial unwrap of the face using the Unwrap from sphere option. The issues are with the ear; it is just a mush of UVs, and the neck, it is stretched and folded under. Too much work to clean up.



Unwrap face only, without ear or neck.

We can tell that the ear would unwrap nicely with just a straightforward projection from the side view, and the neck with a tubular unwrap. So, our general approach will be to unwrap different parts of the object (face, ears, and so on) using different unwrap tool, selecting each tool according to which one works best for that part. So let us begin: We select only the "face" faces, unwrap them using the *Sphere* projection, and scale and rotate them a bit to fit logically within the image area of the UV Editor.



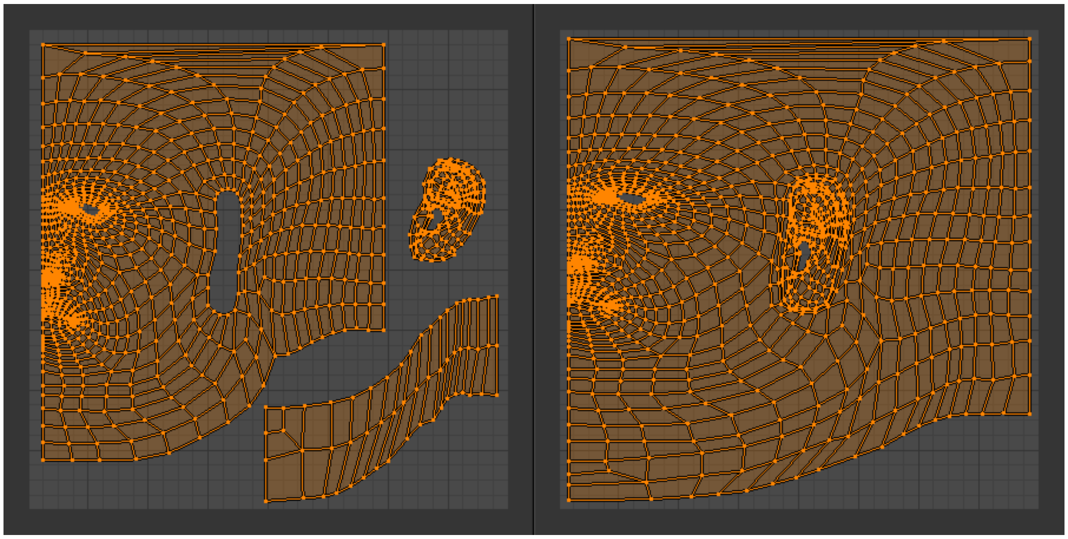
Unwrap ear only, using *Project from View*.

Once we are satisfied with the face, it is time to turn our attention to the ear. First, deselect the faces you were working with. Their UVs will disappear from the UV Editor, but they are still there, just not shown. (To verify this, you can select a few faces in 3D Viewport and it will show up in the UV Editor.)

To work on the ear, in the 3D Viewport, we now select only the “ear” faces. You can use vertex groups to select the ear faces. Selecting sub-meshes is easy too, since they are not connected to the rest of the mesh. Simply selecting linked vertices will select that entire submesh. Basically, since you are in Edit Mode, all the selecting/deselecting features are available to you.

Now unwrap the ear again using the *Project* tool from side view, and scale and rotate them a bit (discussed in the next section), and place them off to the side. You can do this repetitively, using different unwrapping algorithms; each re-apply just puts those UVs for the selected faces somewhere else. Choose the tool for each part that gives you the best fit and most logical layout for subsequent painting of that part.

When all parts of the mesh have been unwrapped using the various methods, you should end up with something that looks like the example to the right. All sections of the mesh have been mapped, and all those maps are laid out in the same UV texture map. Congratulations! From here, it is a simple matter of “stitching” (discussed in the next section) to construct the entire UV map as a single map.



UV maps arranged together and stitched.

When you have completed arranging and stitching, you will end up with a consolidated UV map, like that shown to the right, arranged such that a single image will cover, or paint, all of the mesh that needs detailed painting. All the detailed instructions on how to do this are contained in the next section. The point of this paragraph is to show you the ultimate goal. Note that the mesh shown is Mirrored along the Z axis, so the right side of the face is virtual; it is an exact copy of the right, so only one set of UVs actually exist. (If more realism is desired, the Mirror Modifier would be applied, resulting in a physical mirror and a complete head. You could then make both side physically different by editing one side and not the other. Unwrapping would produce a full set of UVs (for each side) and painting could thus be different for each side of the face, which is more realistic).

Iteration & Refinement

At least for common people, we just do not “get it right the first time.” It takes building on an idea and iterating our creative process until we reach that magical milestone called “Done”. In software development, this is called the ‘spiral methodology’.

Applied to computer graphics, we cycle between modeling, texturing, animating, and then back to making modifications to mesh, UV mapping, tweaking the animation, adding a bone or two, finding out we need a few more faces, so back to modeling, etc. We continue going round and round like this until we either run out of time, money, or patience, or, in rare cases, are actually happy with our results.

Refining the Layout

Refinement comes into play when we finally look at our character, and realize that we need more detail in a particular spot. For example, areas around the eyes might need crow’s feet, or we need to add a logo to the vest. As you start to edit the image, you realize that there just are not enough pixels available to paint the detail that you want.

Your only choice is to expand the size (scale out) that UV face. Using the *Minimize Stretch* or *Scale* tools, you expand the UV faces around the eyes or chest, allocating more pixels to those areas, but at the same time taking away pixels (detail) from somewhere else, like the back of the head. After refining the UV map, you then edit the image so that it looks right and contains the details you want.

Reusing Textures

Another consideration is the need to conserve resources. Each image file is loaded in memory. If you can reuse the same image on different meshes, it saves memory. So, for example, you might want to have a generic face painting, and use that on different characters, but alter the UV map and shape and props (sunglasses) to differentiate.

You might want to have a “faded blue jeans” texture, and unwrap just the legs of characters to use that image. It would be good to have a generic skin image, and use that for character’s hands, feet, arms, legs, and neck. When modeling a fantasy sword, a small image for a piece of the sword blade would suffice, and you would *Reset Unwrap* the sword faces to reuse that image down the length of the blade.

UDIMs

Using UV maps can have one disadvantage, they consist of one texture for the entire mesh. Most of the time this is sufficient but the disadvantage is that the texture is one resolution for the entire mesh. This causes issues if you have a very large mesh with geometry of different importance. When using a singular texture, the resolution might be too low to cover larger UV islands while being inefficient for smaller, less important islands.

UDIM offers a solution to this by being able to spread UV islands across several different textures. UDIM which stands for U DIMension is based on a tile system where each tile is a different texture in the overall UDIM texture array. Basically each tile consists of its own UV space (0-1, 1-2, 2-3) and have its own image assigned to that tile. Tiles are managed in the UDIM Tiles panel where they can have a generated image assigned to them. Generally, you create several textures of different resolutions; for example, you may have a 4k resolution texture for the major details, and 2k and/or 1k textures for less important details.

The UDIM array consists of one main tile, this tile is given the index number of `1001`. The next tile that gets added will be `1002` and will be placed to the right of the main tile. The overall UDIM array is ten tiles wide, so tiles `1001` through `1010` are created on the first row. After ten tiles a new row of tiles is started above the main tile; so `1011` will be place directly above `1001`.

Workflow

To start using a UDIM workflow, you should unwrap a mesh as you would for any other UV map. After that you should decide how many textures you want to split your UV map into. This will be different for every mesh and workflow but a good minimum is 3: one 4k, one 2k, and one 1k image. Then create the desired textures to match how many textures you want.

After this it is the same process of moving UVs to the appropriate tile and scaling and managing them like any other UV map. See Layout Workflow for information on laying out UVs.

When the UVs are correctly set up across the multiple UV islands it is time to add proper textures the UDIM array. Currently, existing textures cannot be added to a tile, to fill a tile with an existing texture you first must:

1. Create the desired tiles.
2. Save the image.
3. Replace the saved image file with the desire texture by deleting the file and replacing it with a new image file, keeping the old file name. Or by opening the image in another application and modifying the contents of the image.

Other than using a third-party application to edit the UDIM texture it is possible to paint on UDIM textures. This works for either 2D Painting or 3D Painting.

File Substitution Tokens

Substitution tokens are special sequences of characters in a filename that can be replaced with more meaningful and context aware information. In this case, tokens are identified by being text wrapped in angle bracket characters.

This substitution is used while load loading or saving an image to automatically identify the tile associated with a particular texture in the UDIM array.

The following tokens are supported:

- `<UDIM>`: A 4-digit notation calculated as `1001 + u-tile + v-tile * 10`.
- `<UVTILE>`: A notation defined as `u(u-tile + 1)_v(v-tile + 1)`.

Examples:

- `monster-basecolor.<UDIM>.png` will load/save files like `monster-basecolor.1021.png` etc.
- `monster-basecolor.<UVTILE>.png` will load/save files like `monster-basecolor.u1_v3.png` etc.

UDIM Tiles

Reference

Editor::	Image Editor, UV Editor
Mode::	All Modes
Panel::	*Sidebar ‣ Image ‣ UDIM Tiles*

In this panel UDIM tiles are managed; new tiles can be added, tiles can be removed, or tiles can filled with a generated texture.

UDIM Tile List

List all UDIM tiles associated with the main index (`1000` tile). Double clicking on the tile name allows you to alter the tiles *Label*.

Add Tile +

Adds new UDIM tiles to the group.

Number

The starting tile index number. UDIMs must start with the `1001` tile and typically increase in incremental order.

Count

The number of tiles to add.

Label

An optional label can be used instead of the index number. These labels are shown in the 2D Viewport.

Fill

Occupy the UDIM tile with a generated image; see *Fill Tile* below.

Remove Tile –

Deletes the selected UDIM tile from the group. If this tile is not saved and contains data, that data will be lost.

Fill Tile

Occupy the UDIM tile with a Generated Image.

Warning

If a tile is not filled, it will not be saved with the image.

Using UV Maps

Sooner or later, you may want to use an image texture on your model. The UV Editor allows you to map textures directly to the mesh faces. The 3D Viewport shows you the object being textured. If you set the 3D Viewport into Textured viewport shading, you will immediately see any changes made in the UV Editor, and vice versa. This is because no real rendering is taking place; it is all just viewport shading. If you were to apply an image to UVs then render, the texture would not show up by default. So to render an image, you must:

- Create a Material for the object.
- Tell Blender to use the UV textures on faces when rendering.

To create a Material, you have to click *Add New* Material in the Shading context.

There are two ways to tell Blender to use the UV texture when rendering; the quick way and the proper way.

The quick way is to use generated UV coordinates. Generated coordinates is used by default by all Texture nodes, with the exception of Image textures that use UV coordinates by default. To use generated coordinates for images as well use the *Generated* output of the Texture Coordinate node.

The proper way is to use UV Unwrapping to manually generate UV coordinates. To use UV mapping, use the Texture Coordinate node (UV output) or the UV Map node and select the UV map to use, “UVMap” by default.

Full details of using Image textures are on the Image Textures page.

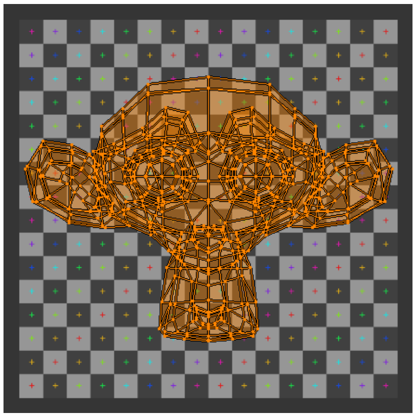
Note

Material is Required for Rendering

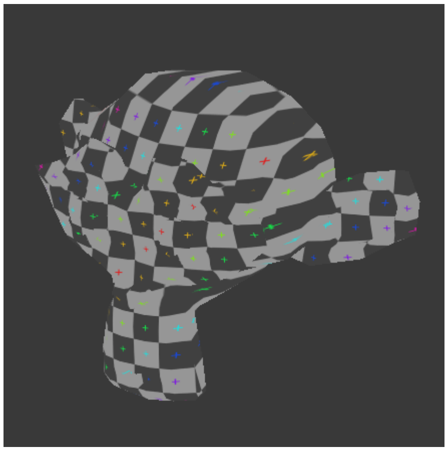
You can perform UV texturing on a mesh within Blender without assigning a material, and you will even see it in your 3D Viewport in textured viewport mode. However, when you render, you will just get a default gray if the object does not have a Material assigned. You will get a black if you do not load an image. If you do not create a texture that uses the image, your object will render according to the procedural material settings.

Using the Test Grid

If your image is a base uniform pattern and you want the application of that image to your model to look like cloth, you do **not** want any stretching (unless you want the cloth to look like spandex). You may also need to test your UV mapping with a test image:



The test grid applied to the UVs.



A preview of the texture on the geometry.

When you render, the mesh will have the test grid as its colors, and the UV texture will be the size image you specified. Note that Blender has a built-in test image. To use it, press the New button of the data-block menu in the Image editor header and change the *Generated Type* to UV Grid.

Modifying Your Image Texture

See also

- Render Bake
- Texture Paint

The advantage to saving as a separate file is that you can easily switch textures just by copying other image files over it, and you can use external editing programs to work on it. The advantage of packing is that your whole project is kept in the blend-file, and that you only have to manage one file.

Mesh Analysis

Reference

Mode::	Edit Mode
Panel::	*Header* ▸ *Overlays* ▸ *Mesh Analysis*

Mesh analysis is useful for displaying attributes of the mesh, that may impact certain use cases.

The mesh analysis works in *Edit Mode* and *Solid* Viewport shading. It shows areas with a high value in red, and areas with a low value in blue. Geometry outside the range is displayed gray.

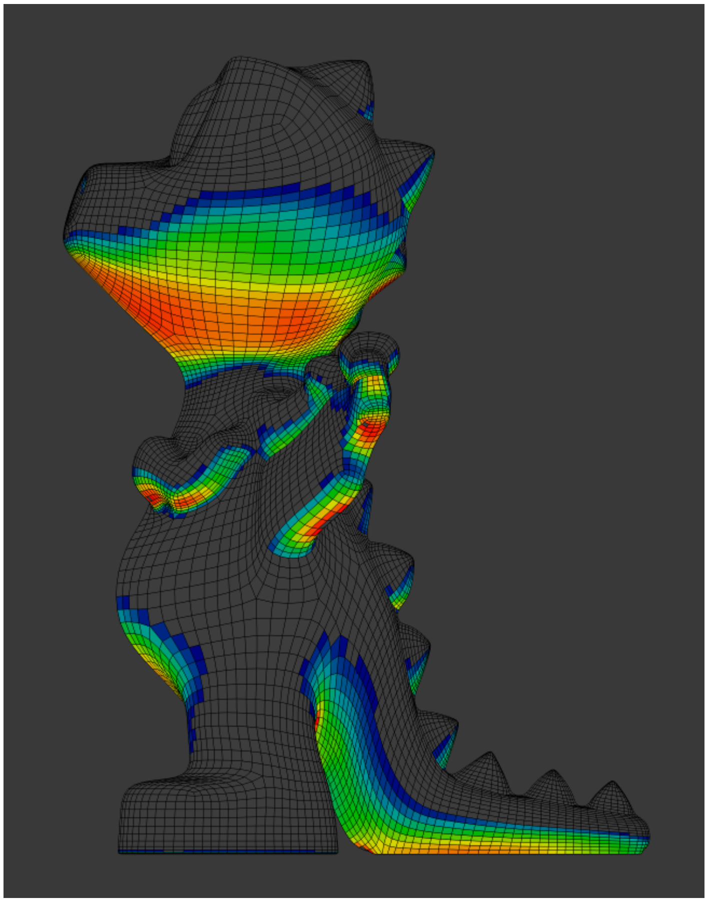
Currently the different modes target 3D printing as their primary use.

Overhang

Extrusion 3D printers have a physical limit to the overhang that can be printed, this display mode shows the overhang with angle range and axis selection.

Minimum/Maximum
    Minimum/Maximum angle to display.

Axis
    Axis and direction to use as the bases to calculate the angle to visualize.



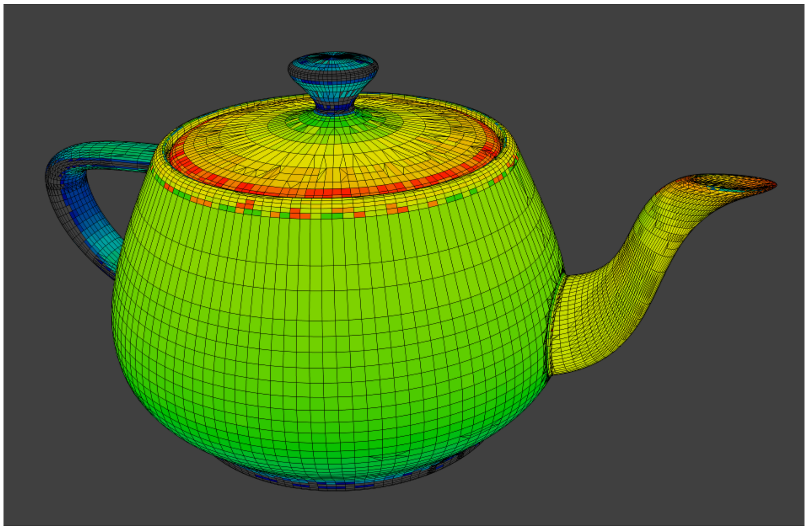
Overhang.

Thickness

Printers have a limited *wall-thickness* where very thin areas cannot be printed, this test uses ray casting and a distance range to the thickness of the geometry.

Minimum/Maximum
  Minimum/Maximum thickness to display.

Samples
  Number of samples to use to calculate the thickness.

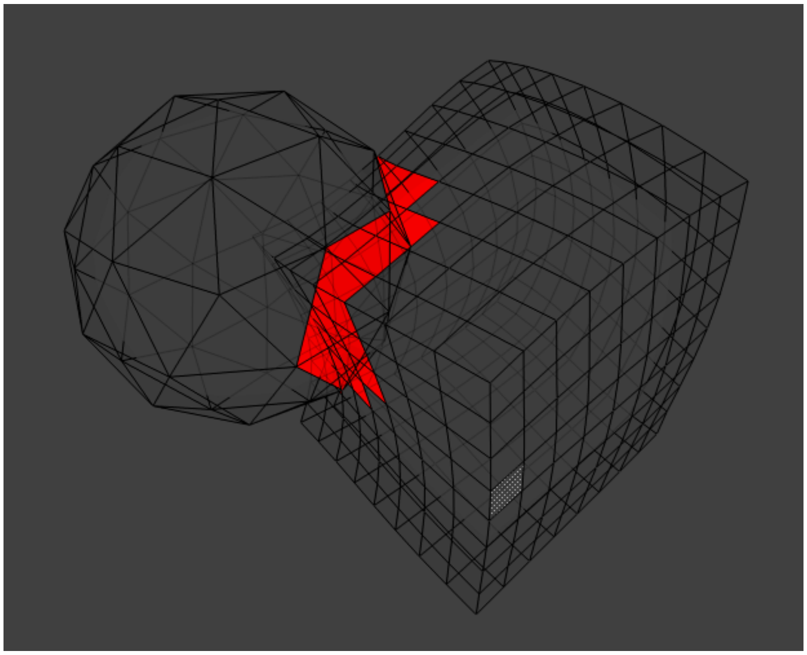


Thickness.

Intersections

Another common cause of problems for printing are intersections between surfaces, where the inside/outside of a model cannot be reliably detected.

Unlike other display modes, intersections have no variance and are either on or off.



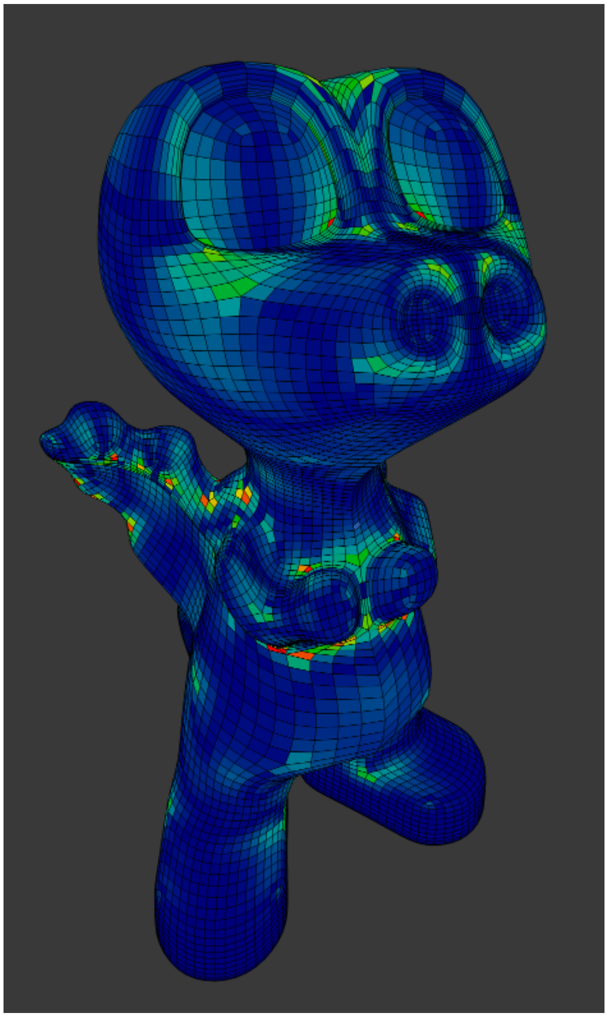
Intersecting faces.

Distortion

Distorted geometry can cause problems since the triangulation of a distorted n-gon is undefined.

Distortion is measured by faces which are not flat, with parts of the face pointing in different directions.

Minimum/Maximum
    Minimum/Maximum distortion to display.

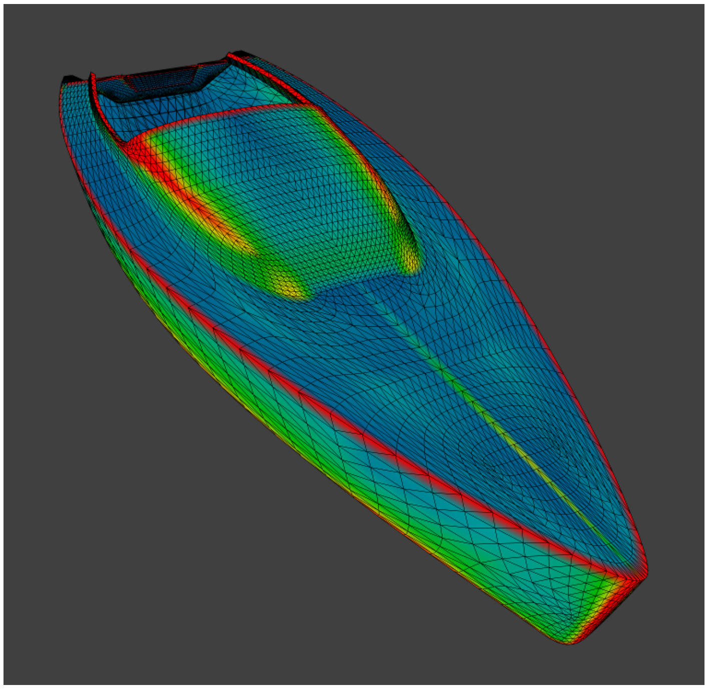


Distorted Faces.

Sharp Edges

Similar to wall-thickness, sharp edges can form shapes that are too thin to be able to print.

Minimum/Maximum
    Minimum/Maximum angle to display.



Sharp edges.

Known Limitations

There are some known limitations with mesh analysis:

- Currently only displayed with Deform Modifiers.
- For high-poly meshes the performance is low while editing.

Retopology

Retopology is the process of simplifying the topology of a mesh to make it cleaner and easier to work with. Retopology is needed for mangled topology resulting from sculpting or generated topology, for example from a 3D scan. Meshes often need to be retopologized if the mesh is going to be deformed in some way. Deformations can include rigging or physics simulations such as cloth or soft body. Retopology can be done by hand by manipulating geometry in Edit Mode or through automated methods.

Using the Poly Build Tool

Todo 2.81.

Remeshing

Reference

Mode::	Object Mode, Sculpt Mode
Panel::	*Properties* ▸ *Object Data* ▸ *Remesh*

Remeshing is a technique that automatically rebuilds the geometry with a more uniform topology. Remeshing can either add or remove the amount of topology depending on a defined resolution. This technique is especially useful for sculpting, to generate better topology after blocking out the initial shape.

Note

Limitations:

- Remeshing only works on the original mesh data and ignores generated geometry from modifiers, shape keys, rigging, etc.

- Remeshing will not work with the Multiresolution Modifier.

See also

Remesh modifier

Voxel

The Voxel Remesher uses OpenVDB to generate a new manifold mesh from the current geometry. It produces a mesh with perfectly even distributed topology and it does not have any performance penalty once the new mesh is calculated. This makes the voxel remesher great for sculpting as it is possible to sculpt at a much higher level of detail than using other features like dyntopo which often adds more performance overhead.

Voxel Size
: The resolution or the amount of detail the remeshed mesh will have. The value is used to define the size, in object space, of the Voxel. These voxels are assembled around the mesh and are used to determine the new geometry. For example a value of 0.5 m will create topological patches that are about 0.5 m (assuming *Preserve Volume* is enabled). Lower values preserve finer details but will result in a mesh with a much more dense topology.

Adaptivity
: Reduces the final face count by simplifying geometry where detail is not needed. This introduce triangulation to faces that do not need as much detail. Note, an *Adaptivity* value greater than zero disables *Fix Poles*.

Fix Poles
: Tries to produce less Poles at the cost of some performance to produce a better topological flow.

Preserve
: Volume

Tells the algorithm to try to preserve the original volume of the mesh. Enabling this could make the operator slower depending on the complexity of the mesh.

Paint Mask
Reprojects the paint mask onto the new mesh.

Face Sets
Reprojects Face Sets onto the new mesh.

Color Attributes
Reprojects the Color Attributes onto the new mesh.

Voxel Remesh
Performs the remeshing operation to create a new manifold mesh based on the volume of the current mesh. Performing this will lose all mesh object data layers associated with the original mesh.

Quad

The Quad remesh uses the Quadriflow algorithm to create a Quad based mesh with few poles and edge loops following the curvature of the surface. This method is relatively slow but generates a higher quality output for final topology.

Warning

Performing *Quadriflow Remesh* will lose all mesh object data layers associated with the original mesh.

Quadriflow Remesh
Opens a pop-up used to set parameters for the remesh operation.

Use Paint Symmetry
Generates a symmetrical mesh using the Mesh Symmetry options.

Preserve Sharp

Tells the algorithm to try to preserve sharp features of the mesh. Enabling this could make the operator slower depending on the complexity of the mesh.

Preserve Mesh Boundary

Tells the algorithm to try to preserve the original volume of the mesh. Enabling this could make the operator slower depending on the complexity of the mesh.

Preserve Paint Mask

Reprojects the Paint Mask onto the new mesh.

Smooth Normals

Applies the Smooth Normals operator to the resulting mesh.

Mode

How to specify the amount of detail for the new mesh.

Ratio::	Specify target number of faces relative to the current mesh.
Edge Length::	Input target edge length in the new mesh.
Faces::	Input target number of faces in the new mesh.

Seed

Random Seed to use with the solver; different seeds will cause the remesher to generate different quad layouts on the mesh.

Curves

- Introduction
- Tools
  - Toolbar
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Introduction

Curves and Surfaces are particular types of Blender objects. They are expressed by mathematical functions (interpolation) rather than linear interpolation between a series of points.

Blender offers both Bézier and NURBS. Both Bézier curves and NURBS curves and surfaces are defined in terms of a set of “control points” (or “control vertices”) which define a “control polygon”.

Blender logo made from Bézier curves.

Both Bézier and NURBS curves are named after their mathematical definitions, and choosing between them is often more a matter of how they are computed behind the scenes than how they appear from a modeler’s perspective. Bézier curves are generally more intuitive because they start and end at the control points that you set, but NURBS curves are more efficient for the computer to calculate when there are many twists and turns in a curve.

The main advantage to using curves instead of polygonal meshes is that curves are defined by less data and so can produce results using less memory and storage space at modeling time. However, this procedural approach to surfaces can increase demands at render time.

Certain modeling techniques, such as extruding a profile along a path, are possible only using curves. On the other hand, when using curves, vertex-level control is more difficult and if fine control is necessary, mesh editing may be a better modeling option.

Bézier curves are the most commonly used curves for designing letters or logos.

They are also widely used in animation, both as for objects to move along (see constraints below) and as F-Curves to change the properties of objects as a function of time.

See also

Modifiers & Constraints

- Curve Modifier
- Follow Path Constraint
- Clamp To Constraint

Tools

- Toolbar

Types

- Draw
- Curve Pen

Toolbar

Curve Edit Mode tools:

Select

Select or move.

Select Box

Select objects by dragging a box.

All objects that intersect the box will be selected.

Select Circle

Select objects by dragging a circle. All objects that intersect the path of the circle will be selected.

Select Lasso

Select objects by drawing a lasso.

Cursor

Change the location of the 3D Cursor.

Move

Translation tool.

Rotate

Rotation tool.

Scale

Scale tool.

Scale Cage

Change the scale of an object by controlling its cage.

Transform

Tool to adjust the objects translation, rotations and scale.

Annotate

Draw free-hand annotation.

Annotate Line

Draw straight line annotation.

Annotate Polygon

Draw a polygon annotation.

Annotate Eraser

Erase previous drawn annotations.

Measure

Measure distances in the scene.

Draw

Free-hand drawing of new curves.

Curve Pen

Construct and edit splines.

Extrude

Extrude the curve by adding new control points.

Radius

Control the radius value of the control points.

Tilt

Control the rotation value of the control points around the curve’s axis.

Randomize

Move selected control points in pseudo-random directions.

Draw

Reference

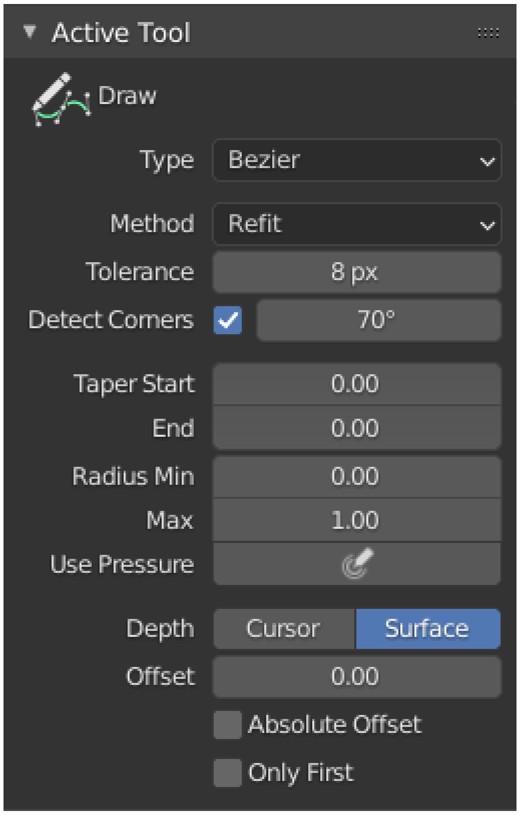
Mode:: Edit Mode
Tool:: *Toolbar ‣ Draw*

The Curve draw tool allows you to free-hand draw curves.

Tool Settings

Type
: Type of curve to use for drawing.

Poly::



Active Tool

Draw

Type: Bezier
Method: Refit
Tolerance: 8 px
Detect Corners: ☑ 70°
Taper Start: 0.00
End: 0.00
Radius Min: 0.00
Max: 1.00
Use Pressure
Depth: Cursor / Surface
Offset: 0.00
☐ Absolute Offset
☐ Only First

Curve Stroke panel.

Bézier Curve with straight line segments (auto handles).

Bézier:: Tolerance

Lower values give a result that is closer to the drawing stroke, while higher values give more smoothed results.

Method

Refit:: Incrementally refits the curve (gives best results).

Split:: Splits the curve until the tolerance is met (gives a better drawing performance).

Detect Corners

Detects corners while drawing based on a specified angle; Any angles above the specified value are considered corners. If a corner is detected, the curve uses non-aligned handles for the corner resulting in a more crisp corner.

Taper Start, End

Taper factor for the radius of the start and end points along the curve.

Radius Min

Minimum radius when the minimum pressure is applied (also the minimum when tapering).

Max

Radius to use when the maximum pressure is applied (or when a tablet is not used).

Use Pressure

Uses stylus pressure to control the radius of the curve.

Depth

Controls where and how the curves are drawn.

Cursor:: Uses the depth under the cursor to draw curves.

Surface:: Used to draw on top of other objects.

Project Onto Selected

Only project the strokes onto selected objects.

Offset

Distance to offset the curve from the surface.

Absolute Offset

Applies a fixed offset (does not scale by the curve radius).

Only First

Only uses the start of the stroke for the depth.

Plane

The orientation plane to draw on, available when *Only First* is enabled.

Normal to Surface:: Draws aligned to the surface.

Tangent to Surface:: Draws perpendicular to the surface.

View:: Draws aligned to the viewport.

Options

After the tool is run, these options are available in the Adjust Last Operation panel.

Error

Error distance in object units. This can be seen similar to a subdivision rate for the curve. Lower values give a result that is closer to the drawing stroke while higher values give more smoothed results.

Fit Method

Refit::	Incrementally refits the curve (gives best results).
Split::	Splits the curve until the tolerance is met (gives a better drawing performance).

Corner Angle

Any angles above this are considered corners.

Cyclic

Toggles whether or not the curve is Cyclic.

Curve Pen

Reference

Mode::	Edit Mode
Tool::	*Toolbar* ▸ *Curve Pen*

The Curve Pen tool allows you to construct and edit curves rapidly.

Usage

The following preferences can be configured from: *Preferences* ▸ *Keymap* ▸ *3D View* ▸ *Curve* ▸ *3D View Tool: Edit Curve, Curve Pen*.

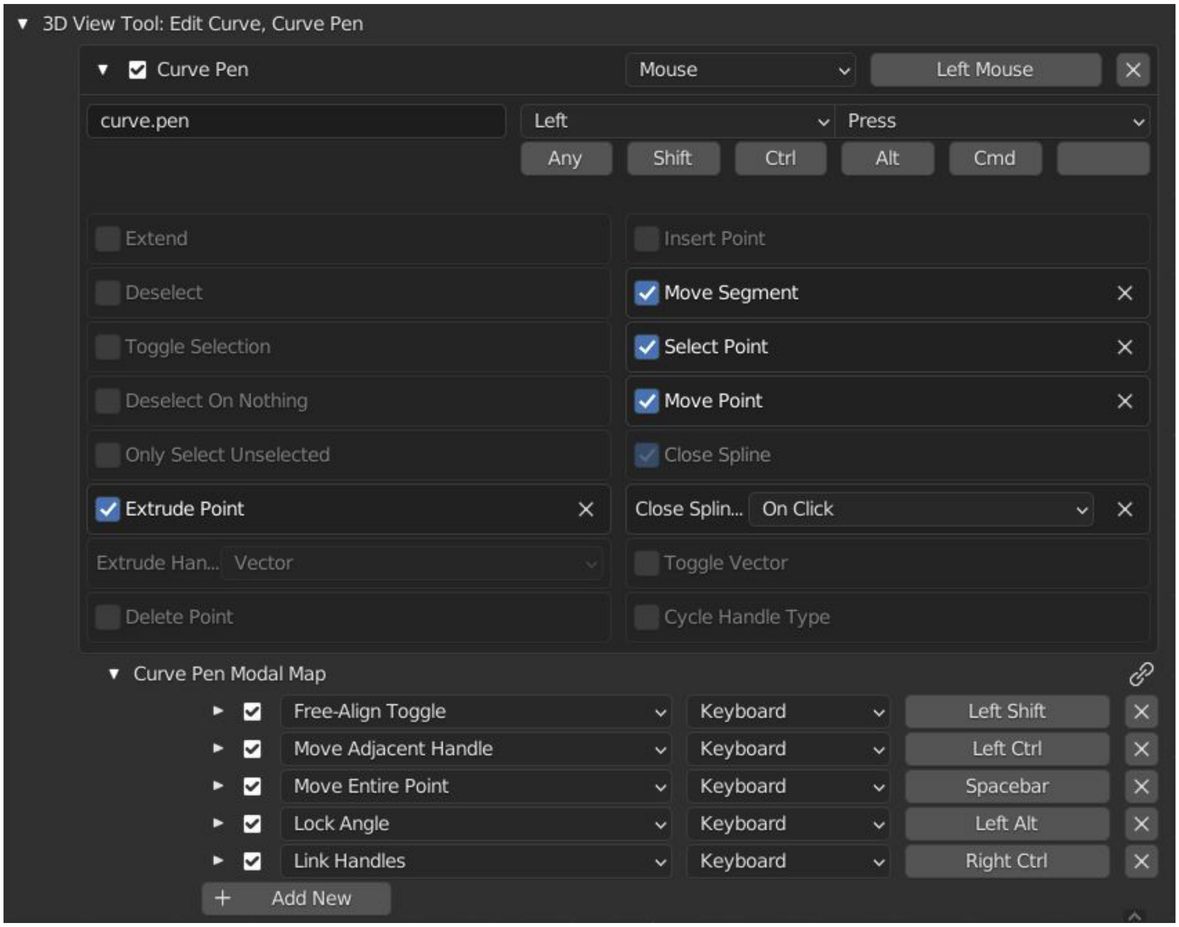
Extrude Point
: `LMB` click to add a new point connected to an existing point.

Extrude Handle Type
: The handle type of the extruded points. Can be either *Vector* or *Auto*. However, the handle type switches to *Align* when handles are moved (See *Move Point*).

Delete Point
: `Ctrl-LMB` click on an existing point to delete it.

Insert Point
: `Ctrl-LMB` click on a Curve Segment to insert a new control point between the two adjacent control points. `Ctrl-LMB` click and drag to control the handles of the inserted points.

Move Segment
: `LMB` drag on a segment in between two control points to adjust the handles, changing the shape of the curve without affecting the location of any control points.


3D View Tool: Edit Curve, Curve Pen
☑ Curve Pen
Mouse
Left Mouse
curve.pen
Left
Press
Any
Shift
Ctrl
Alt
Cmd
☐ Extend
☐ Insert Point
☐ Deselect
☑ Move Segment
☐ Toggle Selection
☑ Select Point
☐ Deselect On Nothing
☑ Move Point
☐ Only Select Unselected
☑ Close Spline
☑ Extrude Point
Close Splin... On Click
Extrude Han... Vector
☐ Toggle Vector
☐ Delete Point
☐ Cycle Handle Type
Curve Pen Modal Map
☑ Free-Align Toggle
Keyboard
Left Shift
☑ Move Adjacent Handle
Keyboard
Left Ctrl
☑ Move Entire Point
Keyboard
Spacebar
☑ Lock Angle
Keyboard
Left Alt
☑ Link Handles
Keyboard
Right Ctrl
Add New

Curve Pen Preferences

Select Point

`LMB` click to select a single point or handle at a time.

Move point

`LMB` drag to move existing points or handles. With an endpoint of a spline selected, click and drag on empty space to *Extrude Point* and move the handle at the same time.

Close Spline

Make the spline Cyclic by clicking the endpoints consecutively.

Close Spline Method

The condition for *Close Spline* to activate.

None::	Turn off the Close Spline functionality.
On Press::	Close the spline on mouse down. With this option, you may click and drag to adjust the handles of the endpoint.
On Click::	Activate on mouse release. With this option, the *Close Spline* functionality will not be triggered on click and drag.

Toggle Vector

Double `LMB` click on a handle to switch handle between *Vector* and *Auto* handle types. Can be used to easily switch between sharp corners and smooth curves.

Cycle Handle Type

Double `LMB` click on the control point to cycle through all handle types.

Hotkeys

Free-Align Toggle

Hold `LeftShift` while dragging a handle to switch between `Free` and `Align` handle types. Can be used to create sharp corners along the curve.

Move Adjacent Handle

Hold `LeftCtrl` while dragging a handle to move the closer handle of the adjacent control point. Can be helpful to make adjustments to newly created curve segments.

Move Entire

Hold `Spacebar` while dragging a handle to move the entire point.

Link Handles

Press `RightCtrl` while dragging a handle to mirror its movement on the opposite handle of the same point.

Lock Handle Angle

Hold `LeftAlt` while dragging a handle to limit the movement of the handle to its current direction, so only its length can be adjusted.

Structure

Splines

Splines are a substructure of curves and are the individual elements that make curve objects. A curve object can be composed of several different splines, just like mesh objects can have different discontinuous meshes under the same object. A spline defines the shape of the curve and can be transformed by altering its Control Points. Splines come in three distinct types, which are described in Spline Types. Each spline type has a slightly different algorithm for computing how bends in the spline are represented.

Splines have their own separate properties from curves and can be altered by selecting the spline in Edit Mode and using the Active Spline panel.

Control Points

Similar to meshes splines have control points or vertices. Control points connect to other control points to form splines. Control points can be selected and transformed to alter the resulting shape of the spline.

See also

Curve Editing

Spline Types

Poly

Poly splines are the most simple spline type as they do not interpolate the shape of the curve between control points.

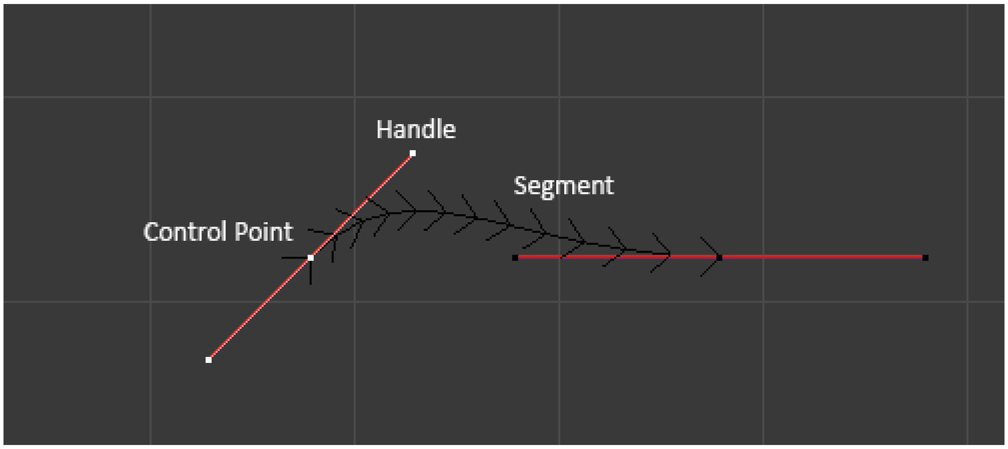
Poly Curves are used when converting meshes to curves. Because they do not interpolate the shape, Poly splines are able to give an accurate representation of the original mesh object.

This is the primary use case of splines, most of the time Bézier or NURBS splines are used instead; both of which interpolate the shape and give smooth results.

Bézier

The main elements used in editing Bézier curves are the control points and handles. A segment (the actual curve) is found between two control points. The handles define the curvature of the segment.

In the image below, the control points can be found in the middle of the pink line, while the handles comprise the extensions from the control point. The arrows visualize the normals of the curve, which indicate i.e. the direction and the tilt.



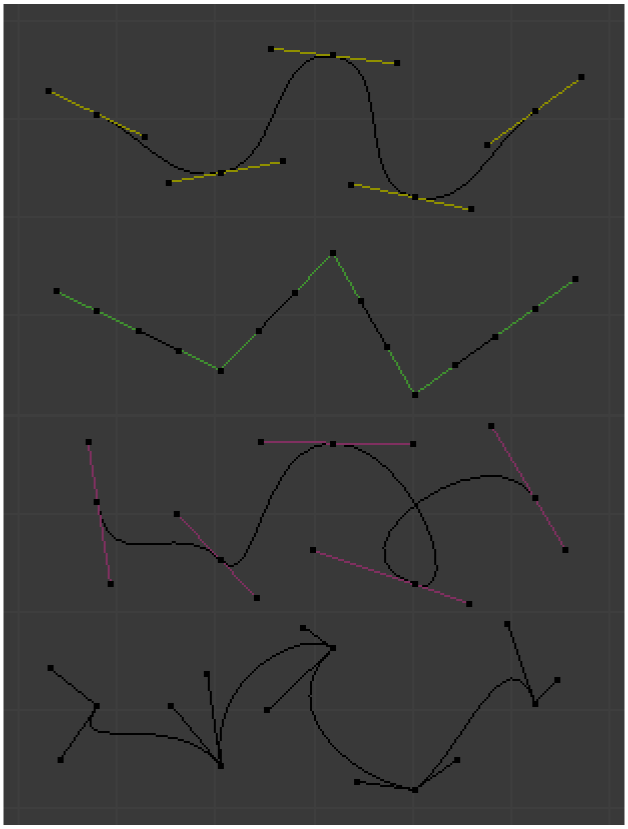
Bézier Curve in Edit Mode.

Handle Types

There are four Bézier curve handle types. They can be accessed by pressing `V` and selecting from the list that appears.

Automatic (yellow handles)
: This handle has a completely automatic length and direction which is set by Blender to ensure the smoothest result. These handles convert to *Aligned* handles when moved.

Vector (green handles)
: Both parts of a handle always point to the previous handle or the next handle which allows you to create curves or sections thereof made of straight lines or with sharp corners. Vector handles convert to *Free* handles when moved.



Bézier Curve Handle Types.

Aligned (purple handles)
: These handles always lie in a straight line, and give a continuous curve without sharp angles.

Free (black handles)
: The handles are independent of each other.

Note

When a control point is selected, its handles are overlaid with a red hilight that changes their color. For example, Vector handles that are normally green will look yellow when selected, which can make it difficult to distinguish them from unselected Automatic handles.

If you prefer not to have this color change, you can disable it by opening the Theme preferences, finding the entry *3D Viewport* ‣ *Active Spline*, and changing it to black. From then on, selected curve handles will simply look a bit brighter than unselected ones.

NURBS

N.U.R.B.S. is the abbreviation for Non-Uniform Rational B-Splines. One of the major differences between Bézier objects and NURBS objects is that Bézier curves are approximations. For example, a Bézier circle is an *approximation* of a circle, whereas a NURBS circle is an *exact* circle. NURBS theory can be a *very* complicated topic. For an introduction, please consult the Wikipedia page.

NURBS spline control points are different than other spline types because they have a special weight property. This weight property controls how much influence the control point has on the surface. This weight should not be confused with the Goal Weight, which is used only for soft body simulations. The NURBS control point weight can be adjusted in the *W* number field of the Transform panel.

Note

If all the control points have the same *Weight* then each effectively cancels each other out. It is the difference in the weights that cause the curve to move towards or away from a control point.

Primitives

Reference

Mode:: Object Mode and Edit Mode
Menu:: *Add* ‣ *Curve*
Shortcut:: `Shift-A`

See also

When adding curves there are some common options like other Objects.

Note

Eventually all the primitive curves will be replaced to use the same curve system used for hair curves. Until this is done, their features will diverge.

They can be converted interchangeably to access the full range of edit and sculpting functionalities.

In Object/Edit Mode, the *Add Curve* menu, provides a few different curve primitives:

Bézier Curve

Adds an open 2D Bézier curve with two control points.

Bézier Circle

Adds a closed, circle-shaped 2D Bézier curve (made of four control points).

NURBS Curve

Adds an open 2D NURBS curve, with four control points, with *Uniform* knots.

NURBS Circle

Adds a closed, circle-shaped 2D NURBS curve (made of eight control points).

Path

Adds a NURBS open 3D curve made of five aligned control points, with *Endpoint* knots and the *Curve Path* setting enabled.

Selecting

This page discusses specific selecting tools for curve objects in Edit Mode. The Curve Edit more also uses the general select tools used which are described in the interface section.

Curve selection in *Edit Mode* has fewer options than with meshes. Mainly this is, because there is only one selectable element type, the control points (no select mode needed here…). These points are a bit more complex than simple vertices, however, especially for Bézier curves, as there is the central vertex, and its two handles…

The basic tools are the same as with meshes, so you can select a simple control point with the `LMB`, add to current selection with `Shift-LMB`, Box Select `B`, and so on.

One word about the Bézier control points: when you select the main central vertex, the two handles are automatically selected too, so you can move it as a whole, without creating an angle in the curve. However, when you select a handle, only this vertex is selected, allowing you to modify this control vector…

Note that, unlike mesh edges, you cannot directly select a segment. Instead, select all of the control points that make up the segment you want to edit.

Select Menu

With curves, all "advanced" selection options are grouped in the *Select* menu of the 3D Viewport header.

All

Reference

Mode:: Edit Mode
Menu:: *Select ‣ All*
Shortcut:: `A`

Select all selectable elements.

None

Reference

Mode:: Edit Mode
Menu:: *Select ‣ None*
Shortcut:: `Alt-A`

Deselect all elements, but the active element stays the same.

Invert

Reference

Mode:: Edit Mode
Menu:: *Select ‣ Invert*
Shortcut:: `Ctrl-I`

Selects all the geometry that are not selected, and deselect currently selected components.

Box Select

Reference

Mode:: Edit Mode
Menu:: *Select ‣ Box Select*
Shortcut:: `B`

Interactive box selection.

Circle Select

Reference

Mode:: Edit Mode
Menu:: *Select ‣ Circle Select*
Shortcut:: `C`

Interactive circle selection.

Lasso Select

Reference

Mode:: Edit Mode
Menu:: *Select ‣ Lasso Select*
Shortcut:: `Ctrl-Alt-LMB`

See Select Lasso.

Select Random

Reference

Mode:: Edit Mode
Menu:: *Select ‣ Select Random*

Select Random control points.

Percent
Selects the defined percentage of control points.

Random Seed

Seed used by the pseudo-random number generator.

Action
: Controls whether the operator *Selects* or *Deselects* control points.

Checker Deselect

Reference

Mode::	Edit Mode
Menu::	*Select ‣ Checker Deselect*

This tool applies an alternating selected/deselected checker pattern. This only works if you already have more than one control point selected.

It works by changing the current selection so that only every Nth control points will remain selected, starting from the active one.

Deselected
: The number of deselected elements in each pattern repetition.

Selected
: The number of selected elements in each pattern repetition.

Offset
: Offset from the starting point.

Select More/Less

Reference

Mode::	Edit Mode
Menu::	*Select ‣ More/Less*
Shortcut::	`Ctrl-NumpadPlus`, `Ctrl-NumpadMinus`

Their purpose, based on the currently selected control points, is to reduce or enlarge this selection.

More
: For each selected control point, select *all* its linked points (i.e. one or two…).

Less
: For each selected control point, if *all* points linked to this point are selected, keep this one selected. Otherwise, deselect it.

This implies two points:

1. When *all* control points of a curve are selected, nothing will happen (as for *Less*, all linked points are always selected, and of course, *More* cannot add any). Conversely, the same goes when no control points are selected.
2. Second, these tools will never “go outside” of a curve (they will never “jump” to another curve in the same object).

Select Linked

Reference

Mode::	Edit Mode
Menu::	*Select ‣ Select Linked*
Shortcut::	`L`, `Ctrl-L`, `Shift-L`

`L` (or `Ctrl-L` for all) will add to the selection the cursor’s nearest control point, and all the linked ones, i.e. all points belonging to the same curve. Note that for Bézier, using `L` with a handle selected will select the whole control point and all the linked ones.

Select Similar

Reference

Mode::	Edit Mode
Menu::	*Select ‣ Select Similar*
Shortcut::	`Shift-G`

Selects control points that have certain similar properties to the active one. The Adjust Last Operation panel provides several selection options:

Type

Type

Selects splines that have the same spline Type i.e. Bézier, NURBS or Poly.

Radius

Selects control points that have a similar Radius value.

Weight

Selects all points that have a similar Weight value.

Direction

Selects control points that have a similar handles direction.

Compare

For quantitative properties, this property selects the type of comparison to between the two numerical values.

Equal::	Select items with the same value as the active item's chosen property.
Greater::	Select items with a larger value as the active item's chosen property.
Less::	Select items with a smaller value as the active item's chosen property.

Threshold

For quantitative properties, this property controls how close the property's values have to be in the comparison.

(De)select First/Last

Reference

Mode:: Edit Mode
Menu:: *Select ▸ (De)select First*, *Select ▸ (De)select Last*

These operators will toggle the selection of the first or last control point(s) of the curve(s) in the object. This is useful to quickly find the start of a curve (e.g. when using it as path…).

Select Next/Previous

Reference

Mode:: Edit Mode
Menu:: *Select ▸ Select Next*, *Select ▸ Select Previous*

These operators will select the next or previous control point(s), based on the current selection (i.e. the control points following or preceding the selected ones along the curve). In case of a cyclic curve, the first and last points are not considered as neighbors.

Pick Shortest Path

Reference

Mode:: Edit Mode
Menu:: *Menu Search ▸ Pick Shortest Path*
Shortcut:: `Ctrl-LMB`

Selects the curve segments between two control points: the active and the one under the cursor. In the case of a closed curve, the shortest path will be selected.

Editing

- Transform Panel
- Curve
    - Transform
    - Mirror
    - Snap
    - Spin
    - Add Duplicate
    - Split
    - Separate
    - Toggle Cyclic
    - Set Spline Type
    - Show/Hide
    - Cleanup
    - Delete
- Control Points
    - Extrude Curve and Move
    - Make Segment
    - Tilt
    - Clear Tilt
    - Set Handle Type
    - Recalculate Handles
    - Smooth
    - Smooth Curve Tilt
    - Smooth Curve Radius
    - Smooth Curve Weight
    - Hooks
    - Make Vertex Parent
- Segments
    - Subdivide
    - Switch Direction
- Other
    - Set Goal Weight
    - Add Vertex

Transform Panel

Reference

Mode:: Edit Mode
Panel:: *Sidebar ‣ Transform*

When nothing is selected, the panel is empty. When more than one vertex is selected, the median values are edited and “Median” is added in front of the labels.

Control Point, Vertex

The first controls (X, Y, Z) show the coordinates of the selected point or handle (vertex). In case of a NURBS curve, there is a fourth component available (W), which defines the weight of the selected control point or the median weight.

Space

The Space radio buttons let you choose if those coordinates are relative to the object origin (local) or the global origin (global).

Global, Local

Weight

Controls the “goal weight” of selected control points, which is used when a curve has Soft Body physics, forcing the curve to “stick” to their original positions, based on the weight.

Radius

Controls the width of the extrusion/bevel along the “spinal” curve. The radius will be interpolated from point to point (you can check it with the normals).

Tilt

Controls how the normals (visualized as arrows) twist around each control point – so it is only relevant with 3D curves! The tilt will be interpolated from point to point (you can check it with the normals).

Curve

This page covers the basics of curve editing.

Transform

Reference

Mode::	Edit Mode
Menu::	*Curve* ‣ *Transform*

A Bézier curve can be edited by transforming the locations of both control points and handles. NURBS curve on the other hand have only control points.

Move, Rotate, Scale
: Like other elements in Blender, curve control points and handles can be moved, rotated, or scaled as described in Basic Transformations.

To Sphere, Shear, Bend, Push/Pull, Warp, Randomize
: The transform tools are described in the Transformations sections.

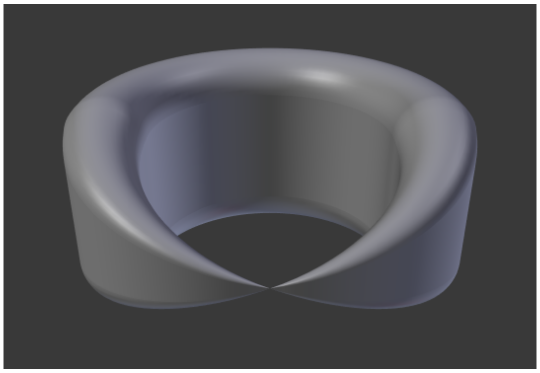
Move/Scale Texture Space
: Like other objects, curves have textures spaces which can be edited.

Radius

Reference

Mode::	Edit Mode
Tool::	*Toolbar* ‣ *Radius*
Menu::	*Curve* ‣ *Transform* ‣ *Radius*
Shortcut::	`Alt-S`

Controls the width of the extrusion along the “spinal” curve. The radius will be interpolated from point to point (you can check it with the normals). The *Radius* of the points is set using the *Radius* transform tool. Or in the Sidebar *Transform* panel.



One control point radius set to zero.

Mirror

Reference

Mode:: Edit Mode
Menu:: *Curve ‣ Mirror*
Shortcut:: `Ctrl-M`

The *Mirror* tool is also available, behaving exactly as with mesh vertices.

Snap

Reference

Mode:: Edit Mode
Menu:: *Curve ‣ Snap*
Shortcut:: `Shift-S`

Mesh snapping also works with curve components. Both control points and their handles will be affected by snapping, except for within itself (other components of the active curve). Snapping works with 2D curves but points will be constrained to the local XY axes.

Spin

Reference

Mode:: Edit Mode
Menu:: *Curve ‣ Spin*

The *Spin* operator only works for one dimensional surface objects. Its use for curves is currently not possible, the full feature is documented in Surface editing.

Add Duplicate

Reference

Mode:: Edit Mode
Menu:: *Curve ‣ Add Duplicate*
Shortcut:: `Shift-D`

Duplicates the selected control points, along with the curve segments implicitly selected (if any). If only a handle is selected, the full point will be duplicated too. The copy is selected so you can move it to another place.

Split

Reference

Mode:: Edit Mode
Menu:: *Curve ‣ Split*

Shortcut:: `Y`

Splits a selected segment of a curve from the rest of the curve. This curve can then be moved or altered without affecting the other curve. If a single control point is selected the *Split* operator will create a new singular loose control point; leaving the previously selected control point attached to the rest of the curve.

Separate

Reference

Mode:: Edit Mode
Menu:: *Curve ‣ Separate*
Shortcut:: `P`

Separates curve objects that are made of multiple distinct curves into their own objects.

Note, if there is only one curve in a Curve object, This operation will create a new Curve object with no control points.

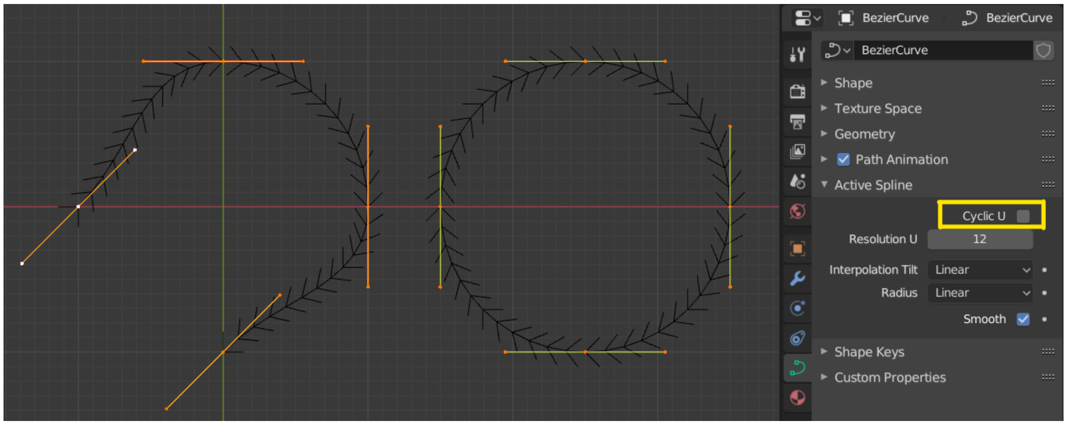
Toggle Cyclic

Reference

Mode:: Edit Mode
Menu:: *Curve ‣ Toggle Cyclic*
Shortcut:: `Alt-C`

Toggles between an open curve and closed curve (Cyclic). Only curves with at least one selected control point will be closed/open. The shape of the closing segment is based on the start and end handles for Bézier curves, and as usual on adjacent control points for NURBS. The only time a handle is adjusted after closing is if the handle is an *Auto* one. Fig. [Open and Closed curves.](#) is the same Bézier curve open and closed.

This action only works on the original starting control point or the last control point added. Deleting a segment(s) does not change how the action applies; it still operates only on the starting and last control points. This means that `Alt-C` may actually join two curves instead of closing a single curve! Remember that when a 2D curve is closed, it creates a renderable flat face.


BezierCurve
BezierCurve
BezierCurve
Shape
Texture Space
Geometry
Path Animation
Active Spline
Shape Keys
Custom Properties

Cyclic U ☐
Resolution U 12
Interpolation Tilt Linear
Radius Linear
Smooth ☑

Open and Closed curves.

Set Spline Type

Reference

Mode:: Edit Mode
Menu:: *Curve ‣ Set Spline Type*

Converts splines in a curve object between Bézier, NURBS, and Poly curves. Note, this is not a “smart” conversion, i.e. Blender does not try to keep the same shape, nor the same number of control points. For example, when converting a NURBS to a Bézier, each group of three NURBS control points become a unique Bézier one (center point and two handles).

See also

Convert/from Mesh.

Show/Hide

Reference

Mode:: Edit Mode
Menu:: *Curve* ‣ *Show/Hide*
Shortcut:: `Alt-H`, `H`, `Shift-H`

When in *Edit Mode*, you can hide and reveal elements from the display. You can only show or hide control points, as segments are always shown, unless all control points of the connected curve are hidden, in which case the curve is fully hidden.

See Show/Hide in *Object Mode*. See also the Curve Display panel.

Cleanup

Decimate Curve

Reference

Mode:: Edit Mode
Menu:: *Curve* ‣ *Clean Up* ‣ *Decimate Curve*

The *Decimate Curve* operator reduces the number of control points while trying to maintain the curves original shape. This operator works similar to its mesh counterpart.

Ratio
    The percentage of control points to remove.

Note

This tool can only decimate Bézier curves.

Delete

Reference

Mode::	Edit Mode
Menu::	*Curve ‣ Delete*
Shortcut::	`X`, `Delete`

Options for the *Delete* pop-up menu:

Vertices
: This will delete the selected control points, *without* breaking the curve (i.e. the adjacent points will be directly linked, joined, once the intermediary ones are deleted). Remember that NURBS order cannot be higher than its number of control points, so it might decrease when you delete some control point. Of course, when only one point remains, there is no more visible curve, and when all points are deleted, the curve itself is deleted.

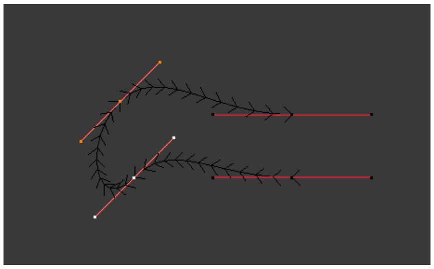
Segment
: Deletes the segment that connects the selected control points and disconnecting them.

Dissolve Vertices

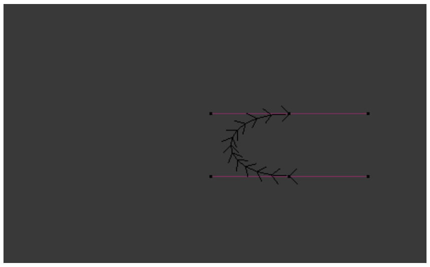
Reference

Mode::	Edit Mode
Menu::	*Curve ‣ Delete ‣ Dissolve Vertices*
Shortcut::	`Ctrl-X`

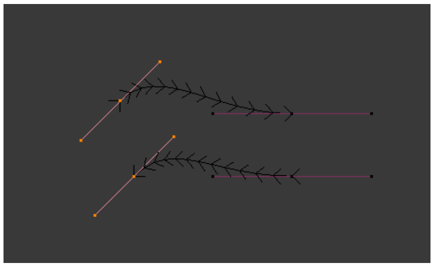
Deletes the selected control points, while the remaining segment is fitted to the deleted curve by adjusting its handles.



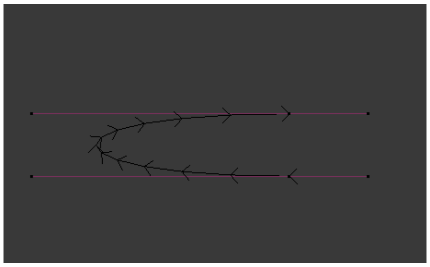
Before deleting.



Deleting vertices.



Deleting segment.



Dissolve vertices.

Control Points

Extrude Curve and Move

Reference

Mode:: Edit Mode
Menu:: *Control Points ‣ Extrude Curve and Move*
Shortcut:: `E`

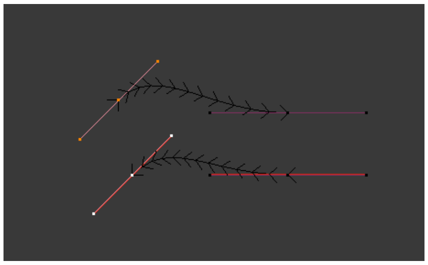
Extrudes points by duplicating the selected points, which then can be moved, and connecting those points back to the original curve creating a continuous curve.

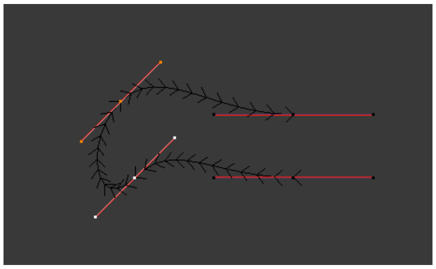
Make Segment

Reference

Mode:: Edit Mode
Menu:: *Control Points ‣ Make Segment*
Shortcut:: `F`

Connects two disconnected control points. The selection must be loose points, or the first/last point of a curve, then press `F`. If the points belong to different curves, these are joined by a segment to become a single curve.





Two curves before. Curve after joining.

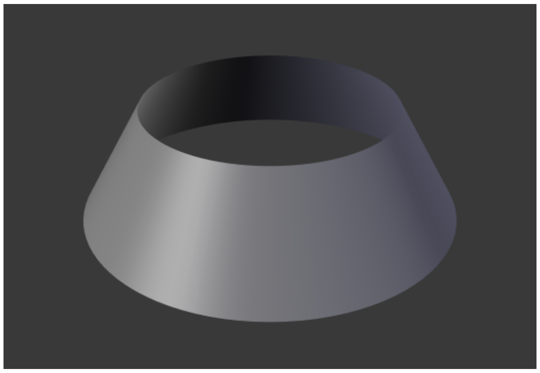
Note that you can only join curves of the same type (i.e. Bézier with Bézier, NURBS with NURBS). Additionally, you can close a curve by toggling cyclic.

Tilt

Reference

Mode::	Edit Mode
Tool::	*Toolbar* ‣ *Tilt*
Menu::	*Control Points* ‣ *Tilt*
Shortcut::	`Ctrl-T`

This setting controls how the normals (visualized as arrows) twist around each control point – so it is only relevant with 3D curves! The tilt will be interpolated from point to point (you can check it with the normals).



30 degree Mean Tilt of all control points.

Clear Tilt

Reference

Mode::	Edit Mode

Menu:: *Control Points ‣ Clear Tilt*
Shortcut:: `Alt-T`

You can also reset the tilt to its default value (i.e. perpendicular to the original curve plane). With NURBS, the tilt is always smoothly interpolated. However, with Bézier, you can choose the interpolation algorithm.

Set Handle Type

Reference

Mode:: Edit Mode
Menu:: *Control Points ‣ Set Handle Type*
Shortcut:: `V`

Handle types are a property of Bézier curves and can be used to alter features of the curve. For example, switching to *Vector handles* can be used to create curves with sharp corners. Read the Bézier curves page for more details.

Toggle Free/Align
: Additionally, this operator can be used to toggle between Free and Aligned handle types.

Recalculate Handles

Reference

Mode:: Edit Mode
Menu:: *Control Points ‣ Recalculate Handles*
Shortcut:: `Shift-N`

The *Recalculate Handles* operator rotates the selected control point's handle to be tangential to the curve. This can be used to make curves smoother and more consistent looking.

Length

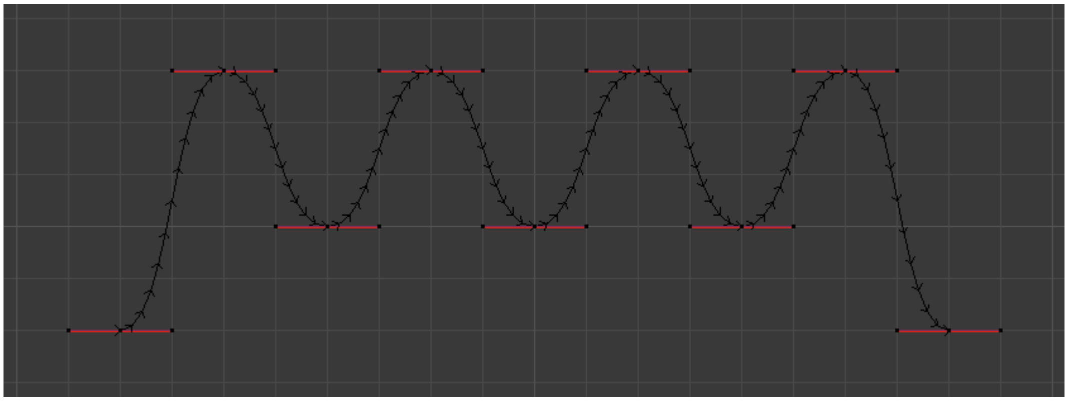
Recalculates the length of the handles so they are all the same length.

Smooth

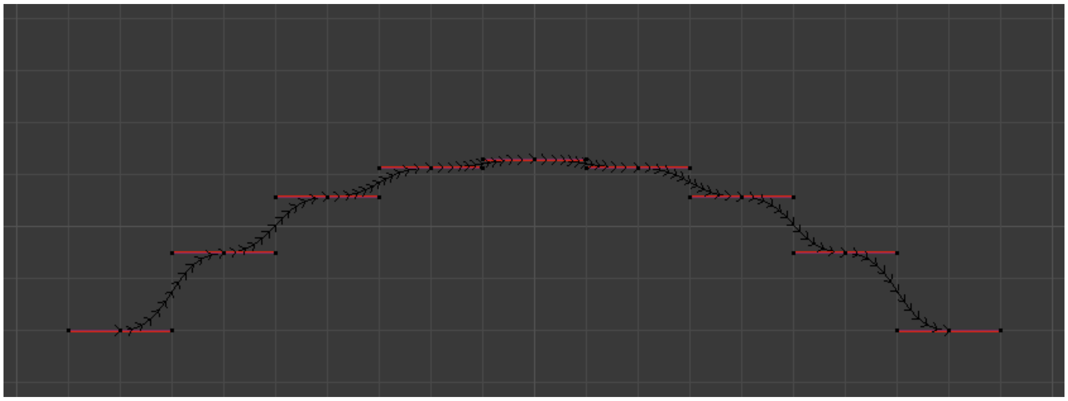
Reference

Mode::	Edit Mode
Menu::	*Control Points ‣ Smooth*

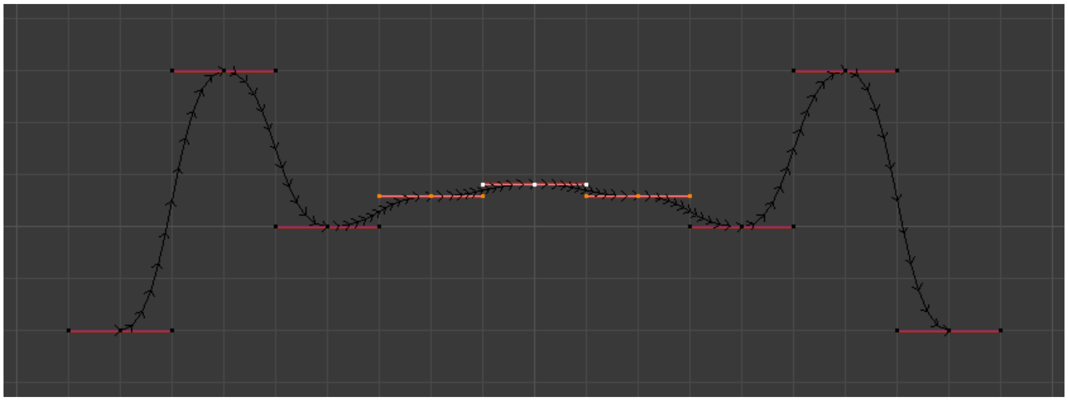
For Bézier curves, this smoothing operation reduces the distance between the selected control point(s) and their neighbors, while keeping the neighbors anchored. Does not effect control point tangents.



Original, unsmoothed Curve.



Entire curve smoothed over 20 times by holding `Shift-R` to repeat last step.



Only three control points in the center smoothed over 20 times.

Smooth Curve Tilt

Reference

Mode::	Edit Mode
Menu::	*Control Points* ‣ *Smooth Curve Tilt*

The *Smooth Curve Tilt* operator interpolates the *Tilt* value for the selected control points. This will reduce sharp changes in the curve's *Tilt* and give a smooth transition between points.

Smooth Curve Radius

Reference

Mode::	Edit Mode
Menu::	*Control Points* ‣ *Smooth Curve Radius*

The *Smooth Curve Radius* operator interpolates the *Radius* value for the selected control points. This will reduce sharp changes in the curve's *Radius* and give a smooth transition between points.

Smooth Curve Weight

Reference

Mode:: Edit Mode
Menu:: *Control Points ‣ Smooth Curve Weight*

The *Smooth Curve Weight* operator interpolates the *Weight* value for the selected control points. This will reduce sharp changes in the curve's *Weight* and give a smooth transition between points.

Hooks

Reference

Mode:: Edit Mode
Menu:: *Control Points ‣ Hooks*
Shortcut:: `Ctrl-H`

Hooks can be added to control one or more points with other objects.

Make Vertex Parent

Reference

Mode:: Edit Mode
Menu:: *Control Points ‣ Make Vertex Parent*
Shortcut:: `Ctrl-P`

You can make other selected objects children of one or three control points, as with mesh objects.

To select a mesh (that is in view) while editing a curve, `Ctrl-P` click on it. Select either one or three control points, then `Ctrl-LMB` the object and use

`Ctrl-P` to make a vertex parent. Selecting three control points will make the child follow the median point between the three vertices. An alternative would be to use a Child Of constraint. See also the Curve modifier.

Segments

Subdivide

Reference

Mode:: Edit Mode
Menu:: *Curve ‣ Segments ‣ Subdivide*

Curve subdivision simply subdivides all selected segments by adding one or more control points between the selected segments.

Number of Cuts
The number of subdivisions to perform.

Switch Direction

Reference

Mode:: Edit Mode
Menu:: *Curve ‣ Segments ‣ Switch Direction*

This tool will “reverse” the direction of any curve with at least one selected element (i.e. the start point will become the end one, and *vice versa*). This is mainly useful when using a curve as path, or using the bevel and taper options.

Other

This page describes other curve editing tools that are not accessible via the edit menus.

Set Goal Weight

Reference

Mode::	Edit Mode
Menu::	*Context Menu ‣ Set Goal Weight*

Sets the curve's Weight for the selected control point to the specified value. If more than one control point is selected this will set the *Mean Weight*.

Add Vertex

Reference

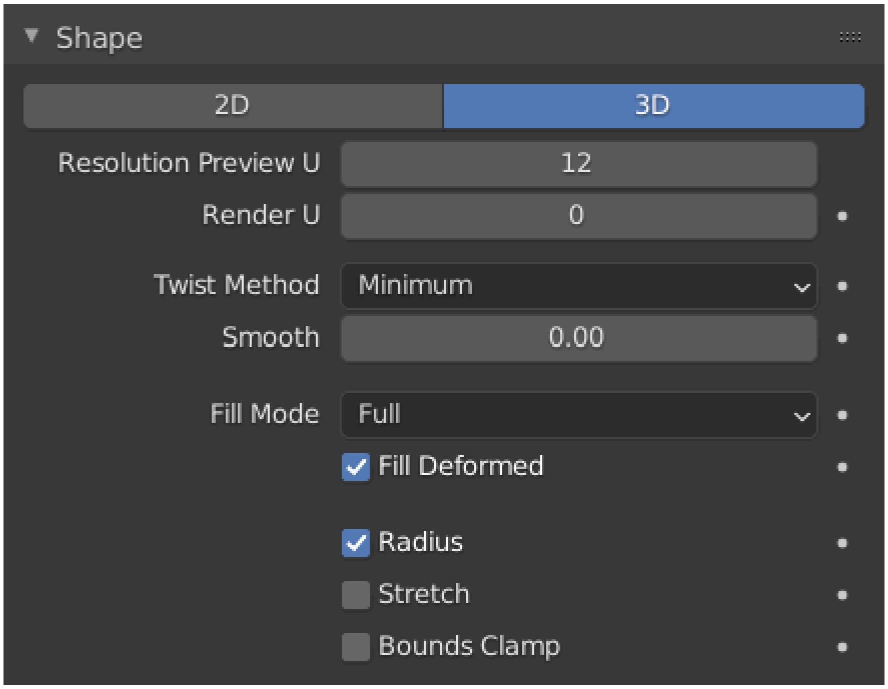
Mode::	Edit Mode
Shortcut::	`Ctrl-RMB`

Interactively places new points with `Ctrl-RMB` at the cursor position. With the selection it deals in same manner as the *Extrude Curve and Move* tool.

Properties

- Shape
- Geometry
  - Bevel
  - Start & End Mapping
  - Examples
- Path Animation
  - Example
- Active Spline
  - Poly
  - Bézier
  - NURBS

Shape



Resolution Preview U: 12
Render U: 0
Twist Method: Minimum
Smooth: 0.00
Fill Mode: Full
☑ Fill Deformed
☑ Radius
☐ Stretch
☐ Bounds Clamp

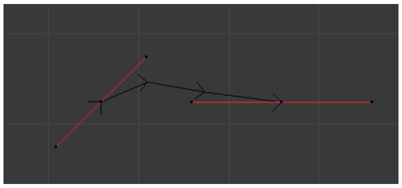
Shape panel.

Dimensions

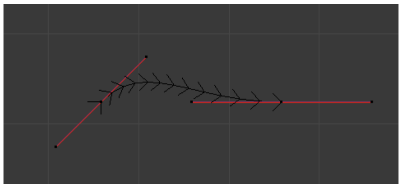
By default, new curves are set to be 3D, which means that control points can be placed anywhere in 3D space. Curves can also be set to 2D which constrain the control points to the curve's local XY axis.

Resolution Preview/Render U

The *resolution* property defines the number of points that are computed between every pair of control points. Curves can be made more or less smooth by increasing and decreasing the resolution respectively. The *Preview U* setting determines the resolution in the 3D Viewport while the *Render U* setting determines the curve's render resolution. If *Render U* is set to zero (0), then the *Preview U* setting is used for both the 3D Viewport and render resolution.



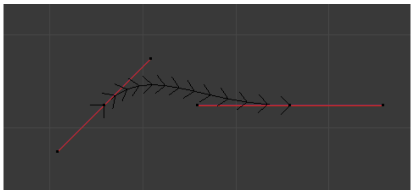
Curves with a resolution of 3.



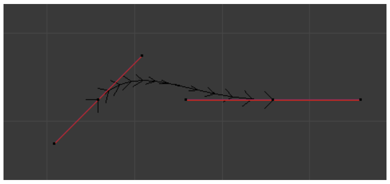
Curves with a resolution of 12.

Twist Method

A 3D curve has control points that are not located on the curve's local XY plane. This gives the curve a twist which can affect the curve normals. You can alter how the twist of the curve is calculated by choosing from *Minimum, Tangent* and *Z-Up* options from the select menu.



Curves with a twist of Minimum.



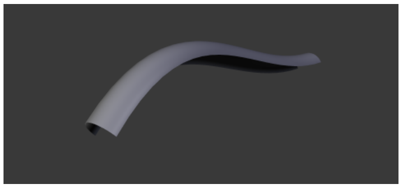
Curves with a twist of Tangent.

Smooth

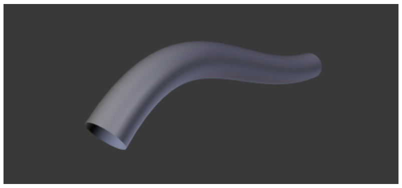
Interactively removes twists from the curve. This is useful if a curve has noticeable "kinks" from over twisting; which can be possible when converting meshes to curves.

Fill Mode

Fill determines the way a curve is displayed when it is beveled (see below for details on Beveling). When set to *Half* the curve is displayed as half a cylinder.



Curves with a fill of Half.



Curves with a fill of Full.

Fill Deformed

Fills the curve after applying all modifications that might deform the curve (i.e. shape keys and modifiers).

Curve Deform

Radius

Causes the deformed object to be scaled by the set curve radius. Utilized when using a curve as a path or when using the Curve Modifier.

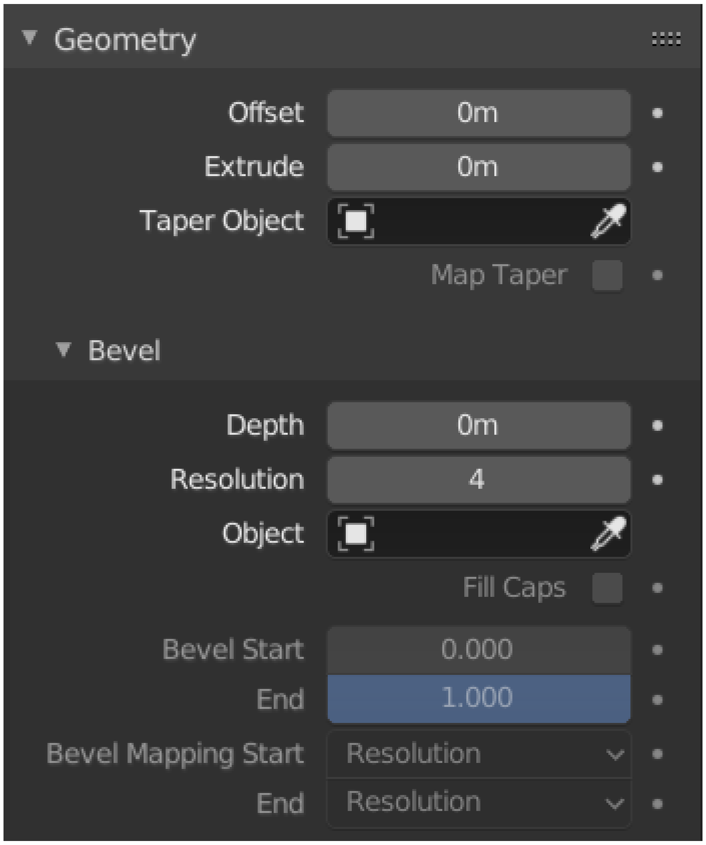
Stretch

The *Stretch* curve option allows you to let the mesh object stretch, or squeeze, over the entire curve. To get the expected result, use this together with the *Bounds Clamp* option. Utilized when using the Curve Modifier.

Bounds Clamp

When this option is enabled, the object and mesh offset along the deformation axis is ignored. This can be useful with the *Stretch* option or when using a negative axis. Utilized when using the Curve Modifier.

Geometry



Geometry

Offset 0m

Extrude 0m

Taper Object

Map Taper ☐

Bevel

Depth 0m

Resolution 4

Object

Fill Caps ☐

Bevel Start 0.000

End 1.000

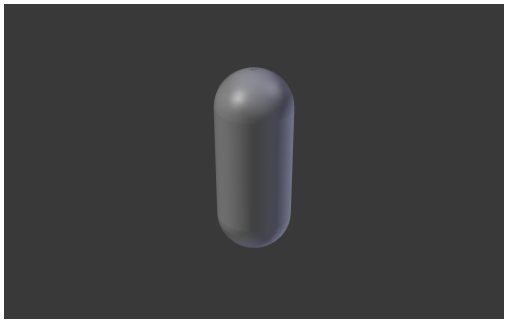
Bevel Mapping Start Resolution

End Resolution

Geometry panel.

Offset

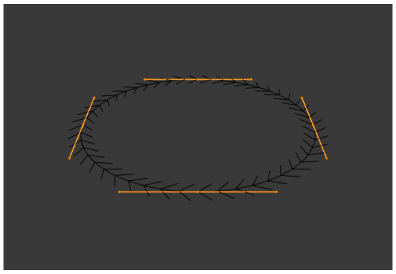
Moves the extrusion parallel to the curve normals.



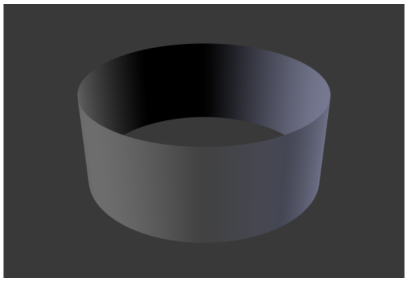
Bézier Circle -1 offset, 0.5 extrusion, 0.25 Bevel Depth, 10 Bevel resolution.

Extrude

Will extrude the curve along both the positive and negative local Z axes. Turns a one-dimensional curve into a two-dimensional curve by giving it height. With a scale is the sum of both directions, perpendicular to the curve's normals.



Bézier Circle 0.0 extrude (Edit Mode).



Extruded by 0.5 (Object Mode).

Taper Object

Tapering a curve causes it to get thinner towards one end. You can also alter the proportions of the Taper throughout the tapered object by moving/scaling/rotating the control points of the Taper Object. The taper curve is evaluated along the local X axis, using the local Y axis for width control. In order for this to work the Taper Object can only be another *open curve*.

The details are:

- The taper is applied independently to all curves of the extruded object.
- Only the first curve in a *Taper Object* is evaluated, even if you have several separated segments.
- The scaling starts at the first control point on the left and moves along the curve to the last control point on the right.

- Negative scaling, (e.g. negative local Y on the taper curve) is possible as well. However, rendering artifacts may appear.
- You may need to increase the curve resolution to see more detail of the taper.
- The Taper Object is distributed by control points. Therefor unevenly spaced control points may likelier to stretch the shape of the taper. Subdividing segments causes those points to use a larger fraction of the overall taper shape.
- With closed curves, the taper curve in *Taper Object* acts along the whole curve (perimeter of the object), not just the length of the object, and varies the extrusion depth. In these cases, you want the relative height of the *Taper Object* Taper curve at both ends to be the same, so that the cyclic point (the place where the endpoint of the curve connects to the beginning) is a smooth transition.

Hint

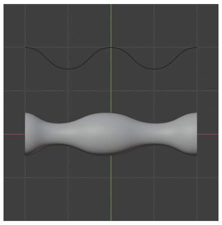
Editing the handles and control points of the Taper Object will instantly change the shape of the original object.

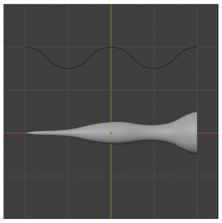
Taper Mode

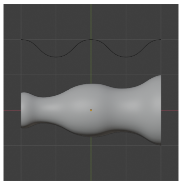
For curves using a *Taper Object*, this option defines how the effective curve radius is computed from the Taper Object.

Override::	The curve radius is ignored and the effective radius is equal to the taper radius.
Multiply::	The effective radius is computed by multiplying the taper radius with the curve radius.
Add::	The effective radius is computed by adding the taper radius to the curve radius.

Examples of a curve with a radius of zero on one end and a radius of one on the other end.


Override mode.


Multiply mode.


Add mode.

Map Taper

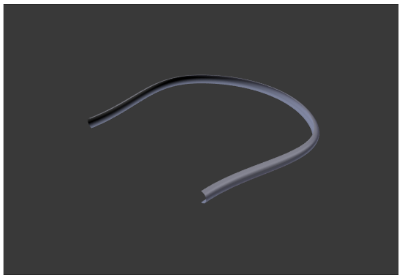
For curves using a Taper Object and with modifications to the *Start/End Bevel Factor* the *Map Taper* option will apply the taper to the beveled part of the curve (not the whole curve).

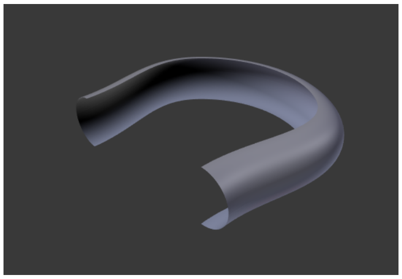
Bevel

Round

Depth

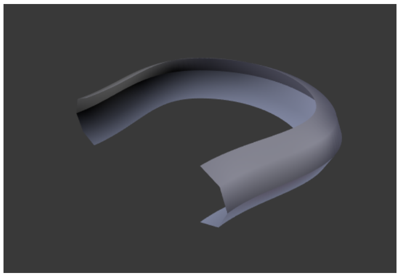
Changes the size of the bevel.


A curve with different Bevel depths applied (Depth of 0.05).

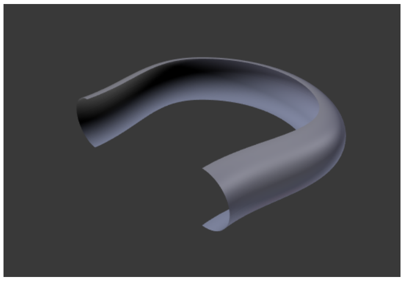

A curve with different Bevel depths applied (Depth of 0.25).

Resolution

Alters the smoothness of the bevel.



A curve with different resolutions applied (Resolution of 1).



A curve with different resolutions applied (Resolution of 12).

Fill Caps
: Seals the ends of a beveled curve.

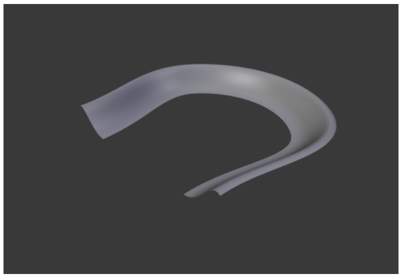
Object

Object
: Here you can specify a profile curve object (opened or closed) which will be extruded along the path curve. If the profile curve's shape is 3D, it will be projected to its local XY plane before the extrusion. You can check what the projected object looks like by switching its shape to 2D.

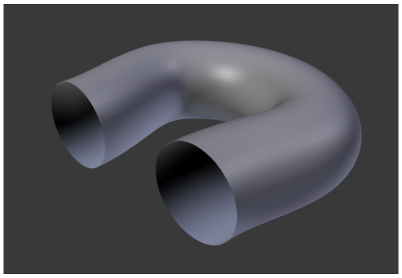
> **Important**
>
> Make sure the shape you want to extrude is in the Object's local XY plane. If it is in the local XZ or YZ plane, it will be reduced to a line when it is projected to the local XY plane. Because of this, the extruded shape will be a flat plane.

> **Note**
>
> If the selected curve has modifiers, these will not be taken into account. The extrusion will use the original curve shape. The reason for this behavior is that curves turn into meshes internally when they have modifiers on them, at which point they can't be used as bevel objects anymore.

To work around this, you can disable beveling on the path curve, and instead add geometry nodes to it: retrieve the profile curve using an Object Info Node, convert it from a mesh back into a curve using a Mesh to Curve Node, and finally pass both the path curve and the profile curve to a Curve to Mesh Node.



A curve with a Bézier curve as the Bevel Object.



A curve with a Bézier circle as the Bevel Object.

Profile

This Curve Widget allows the creation of a user-defined profile with more complexity than with the single profile parameter. The modal tool allows toggling the custom profile, but the shape of the profile is only editable in the options panel after the operation is confirmed.

The profile starts at the bottom right of the widget and ends at the top left, as if it were between two edges intersecting at a right angle. Control points are created in the widget and then the path is sampled with the number of segments from the Bevel modifier.

Note

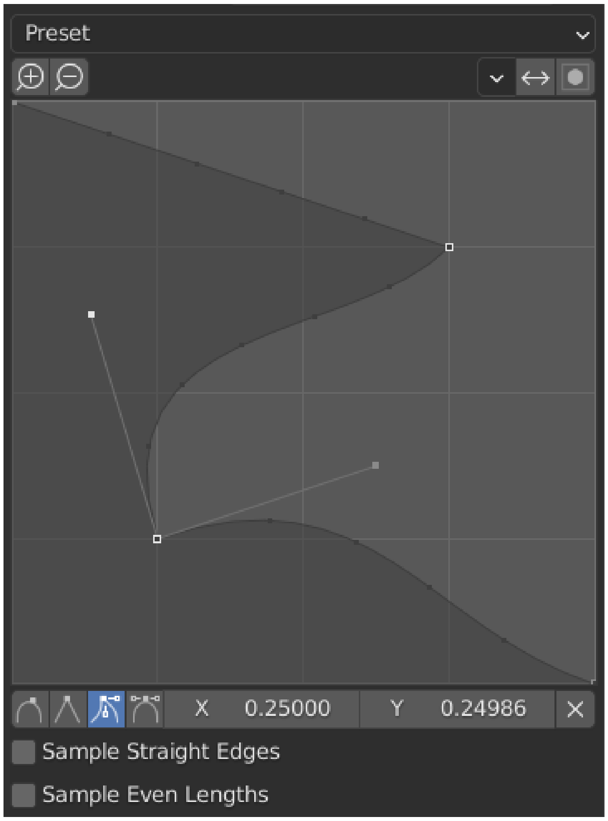
The *Profile* curve widget stays active when miters are enabled because it still controls the shape of the miter profiles.

Presets

The *Support Loops* and *Steps* presets are built dynamically depending on the number of segments in the bevel. If the number of segments is changed, the preset will have to be re-applied.

Sampling

Samples will first be added to each control point, then if there are enough samples, they will be divided evenly between the edges. The *Sample Straight Edges* option toggles whether the samples are added to edges with sharp control points on either side. If there aren't enough samples to give each edge the same number of samples, they will just be added to the most curved edges. So it is recommended to use at least as many segments as there are control points.



X 0.25000 Y 0.24986

☐ Sample Straight Edges

☐ Sample Even Lengths

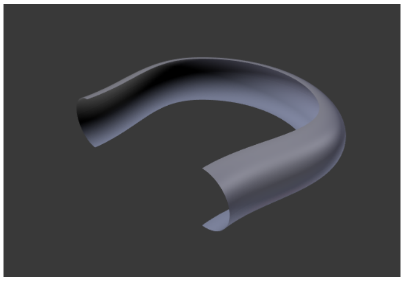
The custom profile widget.

Start & End Mapping

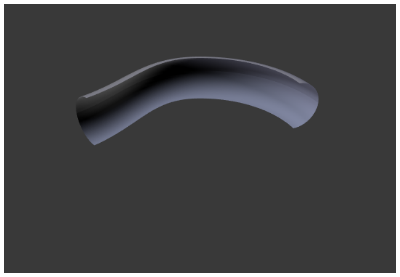
Factor Start, End

These options determine where to start/end the geometry of the curve. This allows to make a curve which is not fully covered with geometry.

A Start value to 0.5 will start the geometry at 50% of the distance from the start of the curve (in effect shortening the curve). An End value of 0.75 will start the geometry at 25% of the distance from the end of the curve (again, shortening the curve).



A curve with no *Factor Start, End*.



A curve with a 0.6 End factor.

Mapping Start, End

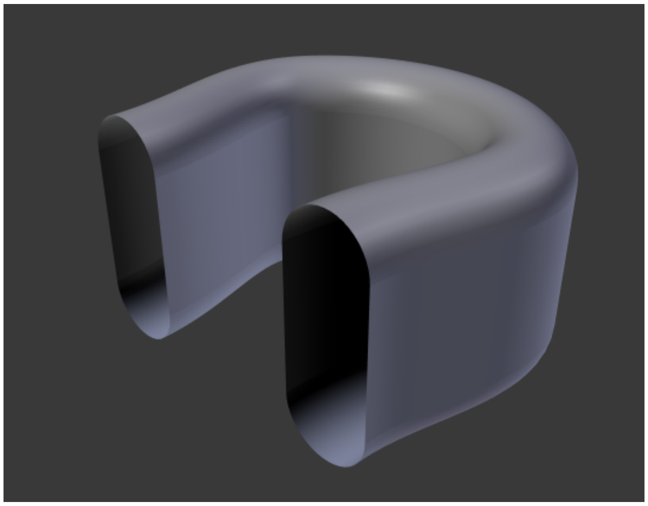
Allows to control the relation between the *Factor Start, End* (number between 0 and 1) and the rendered start and end point of the spline's geometry.

Resolution::	Maps the start and end factor to the number of subdivisions of a spline (U resolution).
Segments::	Maps the start and end factor to the length of its segments. Mapping to segments treats the subdivisions in each segment of a curve as if they would have all the same length.
Spline::	Maps the start and end factor to the length of a spline.

Examples

Open 2D Curve

The extrusion will create a "wall" or "ribbon" following the curve shape. If using a *Bevel Depth*, the wall becomes a sort of slide or gutter. If your normals are facing the wrong way you can switch their direction as shown here.

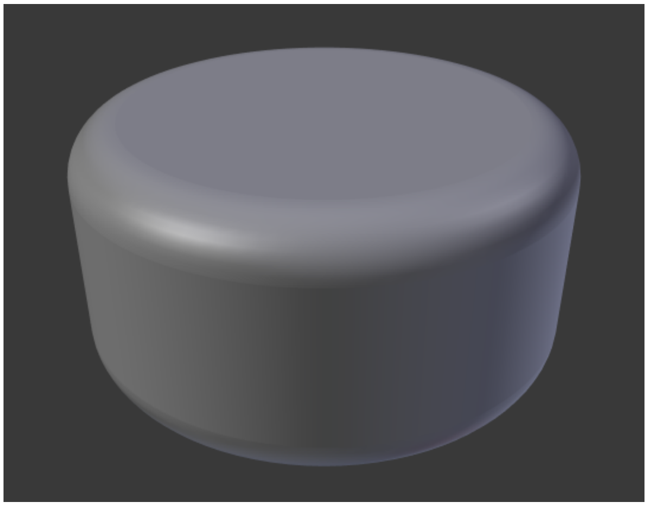


Open 2D Curve with `Alt-C`, fill set to none, zero offset, 0.5 extrusion, 0.25 Bevel Depth, 10 Bevel resolution.

Closed 2D Curve

This is probably the most useful situation, as it will quickly create a volume, with (by default) two flat and parallel surfaces filling the two sides of the extruded “wall”. You can remove one or both of these faces by choosing the fill mode: both, front, back, or none.

The optional bevel depth will always create a 90 degree bevels here.



Closed 2D Curve, 0.5 extrude, 0.25 Bevel Depth, 10 Bevel resolution, Fill: Both.

3D Curve

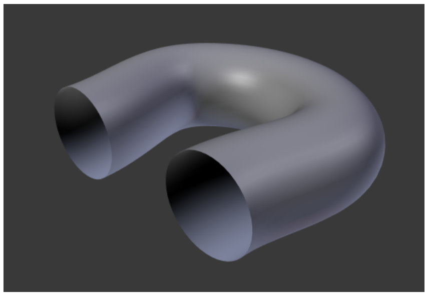
Here the fact that the curve is closed or not has no importance – you will never get a volume with an extruded 3D curve, only a wall or ribbon, like with open 2D curves.

However, there is one more feature with 3D curves: the *Tilt* of the control points (see above). It will make the ribbon twist around the curve to create a Möbius strip, for example.

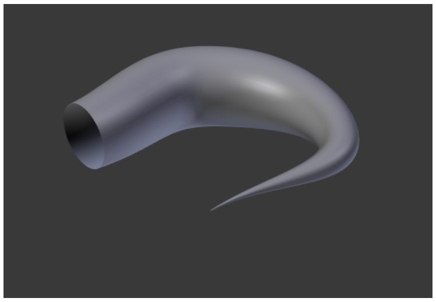
Taper

Let us taper a simple curve circle extruded object using a taper curve. Add a curve, then exit *Edit Mode*. Add another one (a closed one, like a circle); call it "BevelCurve", and enter its name in the *Bevel Object* field of the first curve (*Curve* tab). We now have a pipe. Add a third curve while in *Object Mode* and call it "TaperCurve". Adjust the left control point by raising it up about 5 units.

Now return to the Object tab, and edit the first curve's *Taper Object* field in the Geometry panel to reference the new taper curve which we called "TaperCurve". When you hit enter the taper curve is applied immediately, with the results shown in Fig. Circle curve set as Bevel Object..

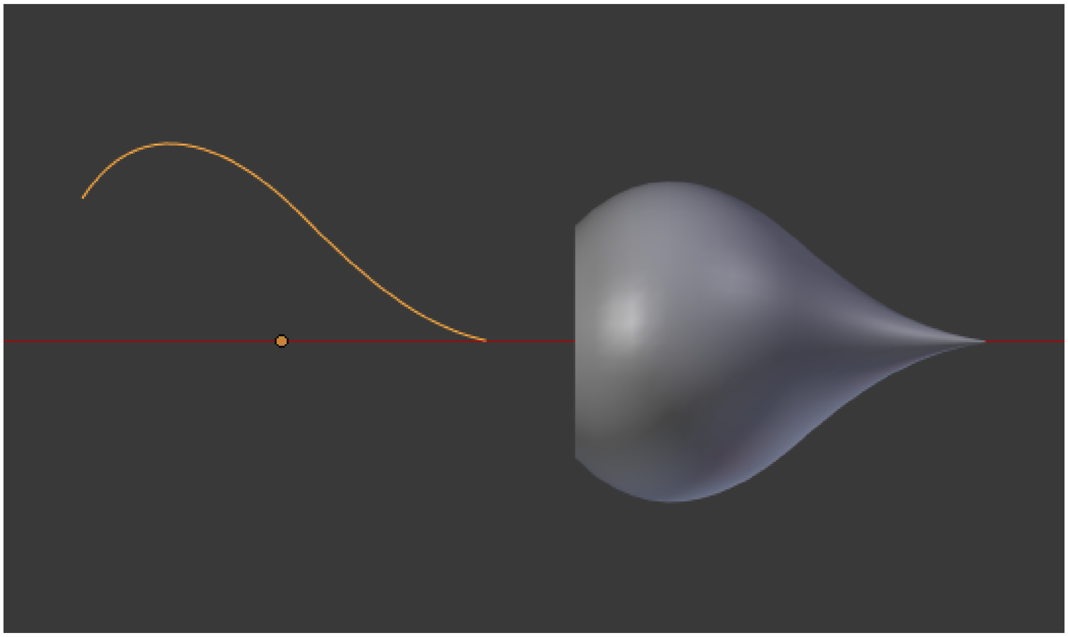


Circle curve set as Bevel Object.



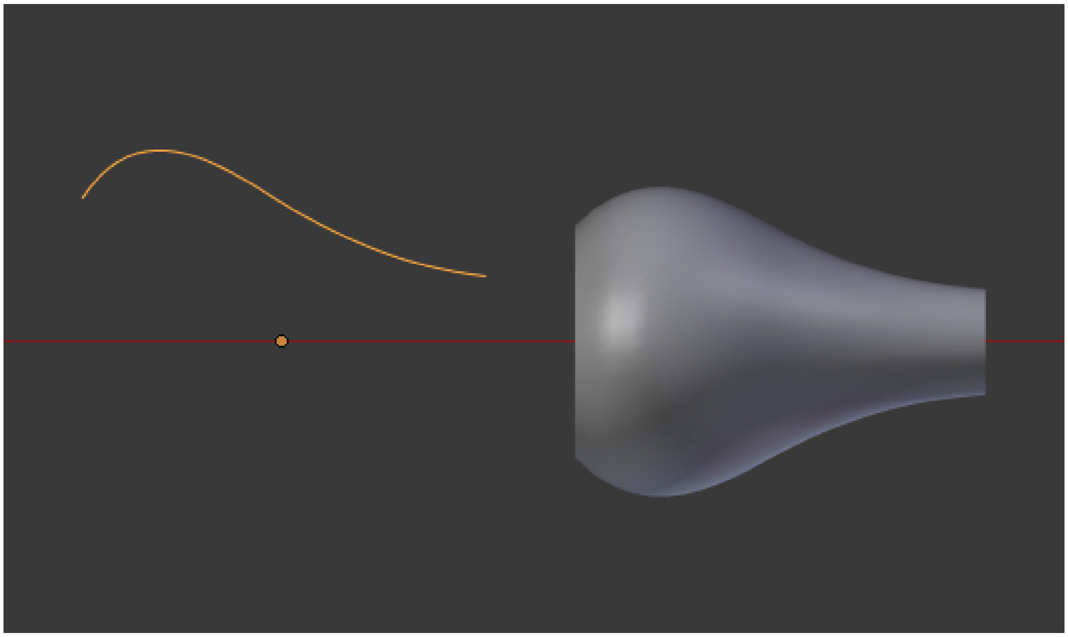
Taper extruded curve.

You can see the *taper curve* being applied to the *extruded object*. Notice how the pipe’s volume shrinks to nothing as the taper curve goes from left to right. If the taper curve went below the local Y axis the pipe’s inside would become the outside, which would lead to rendering artifacts. Of course as an artist that may be what you are looking for!



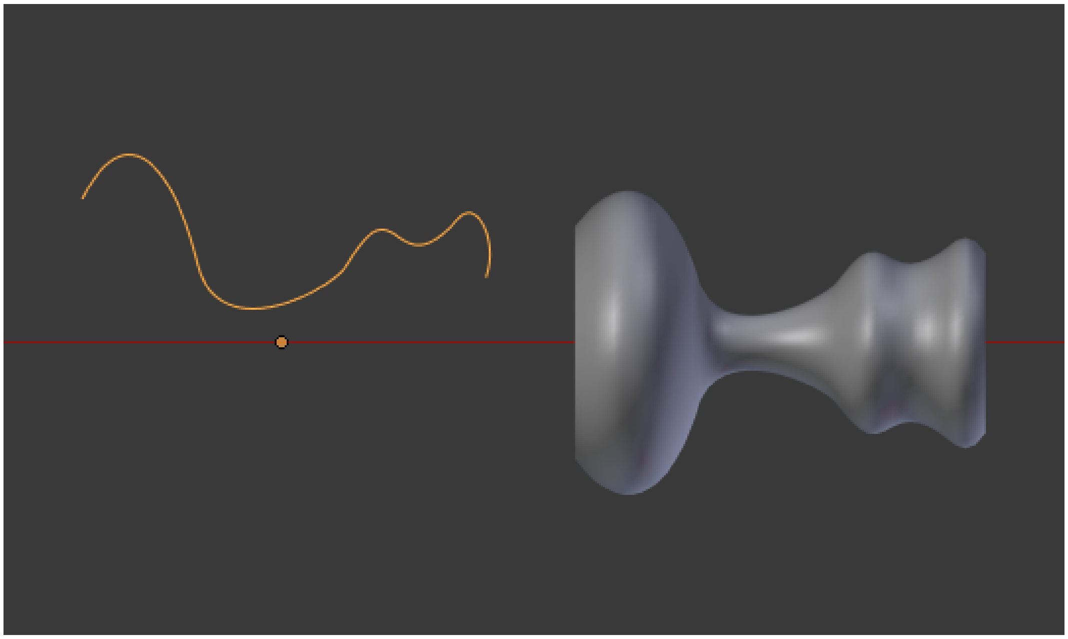
Taper example 1.

In Fig. Taper example 1. you can clearly see the effect the left taper curve has on the right curve object. Here the left taper curve is closer to the object origin and that results in a smaller curve object to the right.



Taper example 2.

In Fig. Taper example 2. a control point in the taper curve to the left is moved away from the origin and that gives a wider result to the curve object on the right.



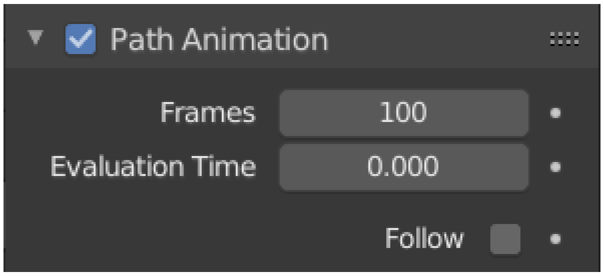
Taper example 3.

Path Animation

The *Path Animation* settings can be used to determine how child objects move along a certain path.

Note

This feature is deprecated, but still available. A more future-proof method is the Follow Path Constraint.



Path Animation panel.

Frames
: The number of frames that are needed to traverse the path, defining the maximum value for the *Evaluation Time* setting.

Evaluation Time
: Parametric position along the length of the curve that object following it should be at (the position is evaluated by dividing by the *Frames* value). By default, it is linked to the global frame number, but could be keyframed to give more control over the path animation.

Clamp
: Clamp the curve path children so they can’t travel past the start/end point of the curve.

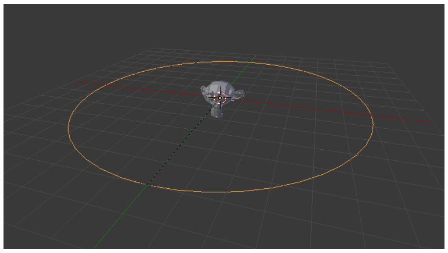
Follow

Make the curve path children rotate along the curvature of the path.

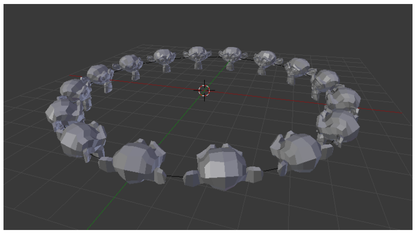
Example

This example shows you how setup a *Path Animation*.

1. Add an object you want to animate and a path along which this object will move. In this example it's the *Monkey* and the *Bézier Circle*.
2. To parent the monkey to the Bézier circle, first select the monkey then the curve (so that the curve is the active object), press `Ctrl-P` and select *Follow Path*. It will automatically animate *Evaluation Time* and activate *Follow* option in the *Path Animation* panel.
3. Select the monkey and Clear Origin to reset its offset.
4. You can change the orientation of the monkey by changing the Tracking Axis.



Monkey parented to the Bézier Circle.



The final result.

Active Spline

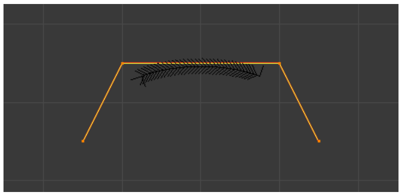
Reference

Mode:: Edit Mode
Menu:: *Properties ‣ Curve ‣ Active Spline*

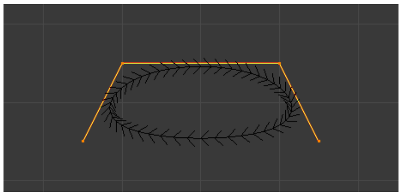
The *Active Spline* panel is used in Edit Mode to control properties of the currently selected spline.

Common Options

Cyclic U
: Closes the active spline.



Default NURBS curve.

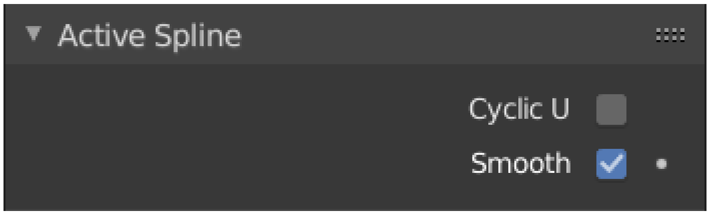


A NURBS curve with Cyclic applied.

Resolution U
: Alters the [resolution](#) of each segment by changing the number of subdivisions.

Smooth
: Use [Smooth Shading](#) for any 3D geometry.

Poly



Cyclic U ☐

Smooth ☑

Active Spline panel: Poly Spline.

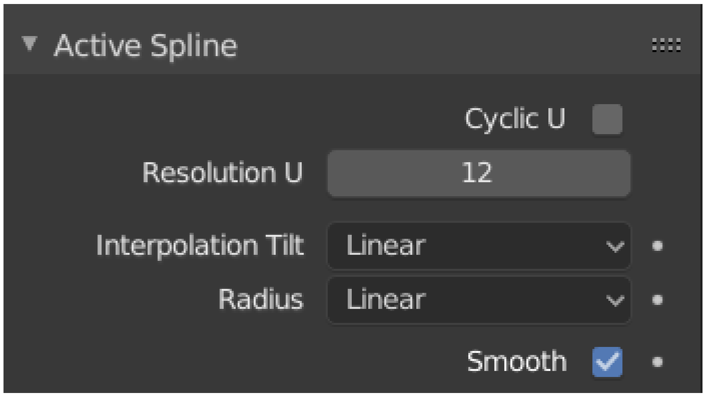
Cyclic U

See Common Options.

Smooth

See Common Options.

Bézier



Cyclic U ☐

Resolution U 12

Interpolation Tilt Linear

Radius Linear

Smooth ☑

Active Spline panel: Bézier Spline.

Cyclic U

See Common Options.

Resolution U

See Common Options.

Interpolation Tilt

Alters how the tilt of a segment is calculated.

Radius

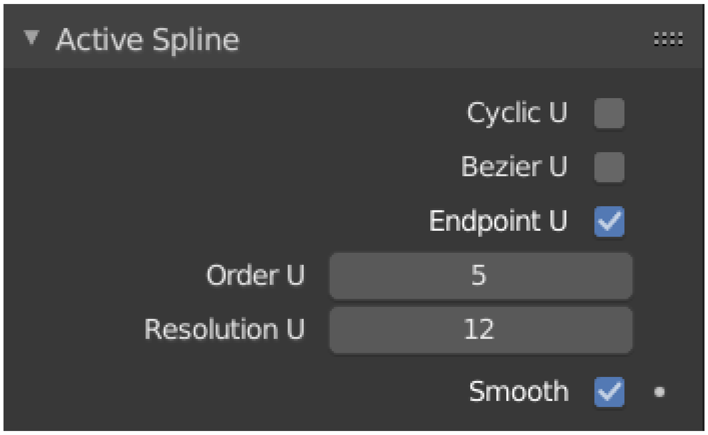
Alters how the radius of a beveled curve is calculated. The effects are easier to see after increasing the radius.

Smooth

See Common Options.

NURBS

One of the characteristics of a NURBS object is the *knot vector*. This is a sequence of numbers used to determine the influence of the control points on the curve. While you cannot edit the knot vectors directly, you can influence them through the *Endpoint* and *Bézier* options in the Active Spline panel. Note that, the *Endpoint* and *Bézier* settings only apply to open NURBS curves.



Active Spline

Cyclic U ☐

Bezier U ☐

Endpoint U ☑

Order U 5

Resolution U 12

Smooth ☑

Active Spline: NURBS Spline.

Cyclic U

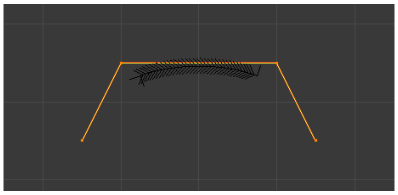
See Common Options.

Bézier U

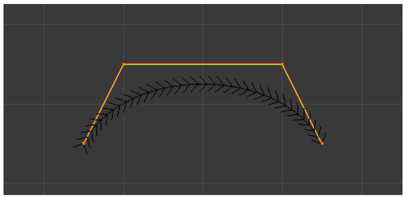
Makes the NURBS curve act like a Bézier curve. The NURBS control points act like *Free* handles of Bézier curve.

Endpoint U

Makes the curve contact the end control points.



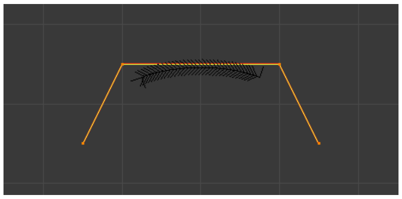
Default NURBS curve.



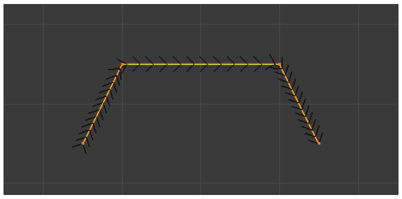
A NURBS curve with Endpoint enabled.

Order U

The order of the NURBS curve determines the area of influence of the control points over the curve. Higher order values means that a single control point has a greater influence over a greater relative proportion of the curve. The valid range of *Order* values is 2-6 depending on the number of control points present in the curve.



NURBS curves with orders of 4.



NURBS curves with orders of 2.

Resolution U

See Common Options.

Smooth

See Common Options.

Curve Display

Reference

Mode:: Edit Mode
Panel:: *3D Viewport ‣ Viewport Overlays ‣ Curve Edit Mode*

When in Edit Mode, curves have special overlays to control how curves are displayed in the 3D Viewport.

Handles
  Toggles the option to display the Bézier handles.

Normals
  Toggles the display of the curve normals.

  Normal Size
    Length of the axis that points the direction of the normal.

Curves (New)

- Tools
    - Toolbar
    - Types
- Primitives
    - Empty Hair
    - Fur
- Selecting
    - Selection Modes
    - All
    - None
    - Invert
    - Select Random
    - Select More/Less
    - Select Linked
    - Select Endpoints
- Editing
    - Curves
    - Control Points
    - Segments
- Properties
    - Attributes
    - Surface

Tools

- Toolbar

Types

- Draw

Toolbar

Curves Edit Mode tools:

Select
: Select or move.

  Select Box
  : Select objects by dragging a box.

    All objects that intersect the box will be selected.

  Select Circle
  : Select objects by dragging a circle. All objects that intersect the path of the circle will be selected.

  Select Lasso
  : Select objects by drawing a lasso.

Cursor
: Change the location of the 3D Cursor.

Move
: Translation tool.

Rotate
: Rotation tool.

Scale
: Scale tool.

  Scale Cage
  : Change the scale of an object by controlling its cage.

Transform

Tool to adjust the objects translation, rotations and scale.

Annotate

Draw free-hand annotation.

- Annotate Line

  Draw straight line annotation.

- Annotate Polygon

  Draw a polygon annotation.

- Annotate Eraser

  Erase previous drawn annotations.

Measure

Measure distances in the scene.

Draw

Free-hand drawing of new curves.

Radius

Control the radius value of the control points.

Tilt

Control the rotation value of the control points around the curve's axis.

Draw

Reference

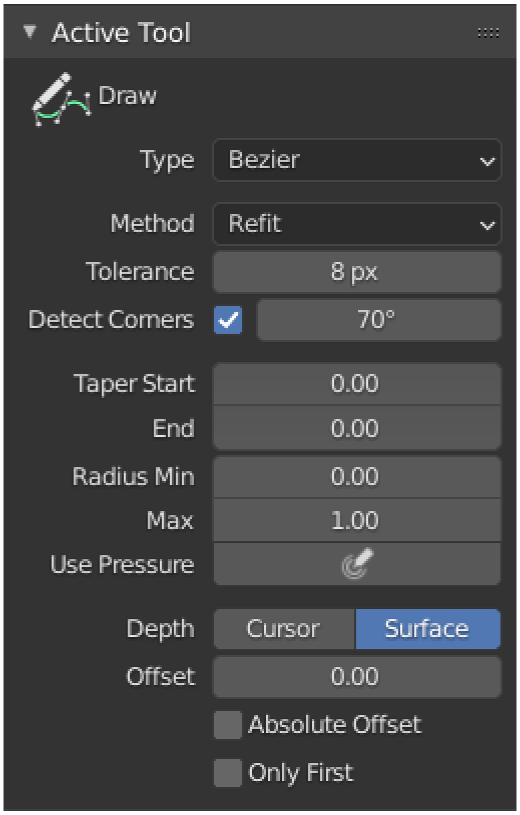
Mode::	Edit Mode
Tool::	*Toolbar ‣ Draw*

The Curve draw tool allows you to free-hand draw curves.

Tool Settings

Type
: Type of curve to use for drawing.

Poly::



Active Tool

Draw

Type Bezier

Method Refit

Tolerance 8 px

Detect Corners ☑ 70°

Taper Start 0.00

End 0.00

Radius Min 0.00

Max 1.00

Use Pressure

Depth Cursor ● Surface

Offset 0.00

☐ Absolute Offset

☐ Only First

Curve Stroke panel.

Bézier Curve with straight line segments (auto handles).

Bézier:: Tolerance

Lower values give a result that is closer to the drawing stroke, while higher values give more smoothed results.

Method

Refit:: Incrementally refits the curve (gives best results).

Split:: Splits the curve until the tolerance is met (gives a better drawing performance).

Detect Corners

Detects corners while drawing based on a specified angle; Any angles above the specified value are considered corners. If a corner is detected, the curve uses non-aligned handles for the corner resulting in a more crisp corner.

Taper Start, End

Taper factor for the radius of the start and end points along the curve.

Radius Min

Minimum radius when the minimum pressure is applied (also the minimum when tapering).

Max

Radius to use when the maximum pressure is applied (or when a tablet is not used).

Use Pressure

Uses stylus pressure to control the radius of the curve.

Depth

Controls where and how the curves are drawn.

Cursor::	Uses the depth under the cursor to draw curves.
Surface::	Used to draw on top of other objects. Project Onto Selected Only project the strokes onto selected objects. Offset Distance to offset the curve from the surface. Absolute Offset Applies a fixed offset (does not scale by the curve radius). Only First Only uses the start of the stroke for the depth. Plane The orientation plane to draw on, available when *Only First* is enabled. **Normal to Surface::** Draws aligned to the surface. **Tangent to Surface::** Draws perpendicular to the surface. **View::** Draws aligned to the viewport.

Curve 2D

Project the curve on the Z axis.

As NURBS

Draw curves as a NURBS curve with Bézier knot mode, instead of a Bézier curve.

Options

After the tool is run, these options are available in the Adjust Last Operation panel.

Error

Error distance in object units. This can be seen similar to a subdivision rate for the curve. Lower values give a result that is closer to the drawing stroke while higher values give more smoothed results.

Fit Method

Refit::	Incrementally refits the curve (gives best results).
Split::	Splits the curve until the tolerance is met (gives a better drawing performance).

Corner Angle

Any angles above this are considered corners.

Cyclic

Toggles whether or not the curve is Cyclic.

Primitives

Empty Hair

Adds an empty high-performance curves object and automatically:

- Assigns the active object as the Surface.
- Set the surface object as the parent of the new object.
- Adds a Geometry Nodes modifier to deform the curves on the surface.

Fur

Adds a fur setup to the selected objects. The fur setup is based on Geometry Nodes and built with Hair Node Groups that come with Blender as bundled assets.

See Quick Fur for more information.

Selecting

Hair curves, while similar to regular curves are a bit different and have their own selection tools. Many of these match their regular curve tools but are implemented differently All hair curve selection operators are documented below for completeness.

These selection operators work in both Sculpt and Edit modes.

Selection Modes

Reference

Mode::	Edit Mode
Menu::	*3D Viewport Header ‣ Select Mode*
Shortcut::	`1`, `2`

Note, this is only supported for “Hair Curves”.

Selection modes limits selection operators to certain curve domains. This feature is makes it easy to select whole segments at once, or to give more granular control over editing.

Control Points::	Allows selection of individual control points.
Curve::	Limits selection to whole curve segments.

All

Reference

Mode::	Edit Mode
Menu::	*Select ‣ All*
Shortcut::	

`A`

Select all selectable elements.

None

Reference

Mode::	Edit Mode
Menu::	*Select ‣ None*
Shortcut::	`Alt-A`

Deselect all elements, but the active element stays the same.

Invert

Reference

Mode::	Edit Mode
Menu::	*Select ‣ Invert*
Shortcut::	`Ctrl-I`

Selects all the geometry that are not selected, and deselect currently selected components.

Select Random

Reference

Mode::	Edit Mode
Menu::	*Select ‣ Select Random*

Select Random control points.

Seed

Seed used by the pseudo-random number generator.

Probability

Selects the defined percentage of control points.

Select More/Less

Reference

Mode::	Edit Mode
Menu::	*Select ‣ More/Less*
Shortcut::	`Ctrl-NumpadPlus`, `Ctrl-NumpadMinus`

Their purpose, based on the currently selected control points, is to reduce or enlarge this selection.

More

For each selected control point, select *all* its linked points (i.e. one or two…).

Less

For each selected control point, if *all* points linked to this point are selected, keep this one selected. Otherwise, deselect it.

This implies two points:

1. When *all* control points of a curve are selected, nothing will happen (as for *Less*, all linked points are always selected, and of course, *More* cannot add any). Conversely, the same goes when no control points are selected.
2. Second, these tools will never “go outside” of a curve (they will never “jump” to another curve in the same object).

Select Linked

Reference

Mode:: Edit Mode
Menu:: *Select ‣ Select Linked*
Shortcut:: `L`, `Ctrl-L`, `Shift-L`

`L` (or `Ctrl-L` for all) will add to the selection the cursor's nearest control point, and all the linked ones, i.e. all points belonging to the same curve. Note that for Bézier, using `L` with a handle selected will select the whole control point and all the linked ones.

Select Endpoints

Reference

Mode:: Edit Mode
Menu:: *Select ‣ Select Endpoints*

Select endpoints of curves. Only supported in the Control Point selection mode.

Editing

The curves can be edited via sculpting.

Curves objects also have basic editing support in “Edit Mode”.

- Curves
  - Transform
  - Duplicate
  - Delete
  - Toggle Cyclic
  - Set Curve Type
- Control Points
  - Extrude Curve and Move
  - Tilt
  - Clear Tilt
  - Set Handle Type
- Segments
  - Subdivide
  - Switch Direction

Curves

Transform

Reference

Mode::	Edit Mode
Menu::	*Curves* ‣ *Transform*

A curves objects can be edited by transforming the locations of control points.

Move, Rotate, Scale
: Like other elements in Blender, control points can be moved, rotated, or scaled as described in Basic Transformations.

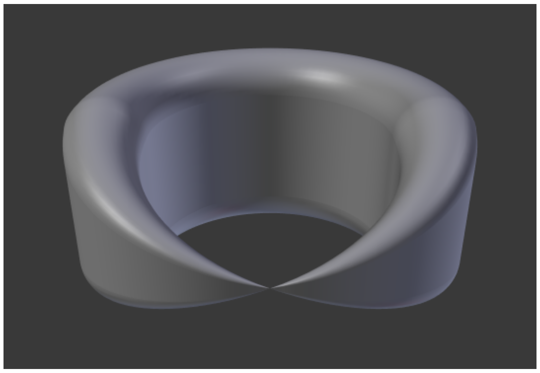
To Sphere, Shear, Bend, Push/Pull
: The transform tools are described in the Transformations sections.

Radius

Reference

Mode::	Edit Mode
Tool::	*Toolbar* ‣ *Radius*
Menu::	*Curves* ‣ *Transform* ‣ *Radius*
Shortcut::	`Alt-S`

The Radius allows you to directly control the width of the extrusion along the “spinal” curve. The radius will be interpolated from point to point (you can check it with the normals). The *Radius* of the points is set using the *Radius* transform tool. Or in the Sidebar *Transform* panel.



One control point radius set to zero.

Duplicate

Reference

Mode::	Edit Mode
Menu::	*Curves ‣ Duplicate*
Shortcut::	`Shift-D`

This operator duplicates the selected control points, along with the curve segments implicitly selected (if any). .. If only a handle is selected, the full point will be duplicated too. The copy is selected so you can move it to another place.

Delete

Reference

Mode::	Edit Mode
Menu::	*Curves ‣ Delete*
Shortcut::	`X`

The Delete operator can remove Control Points or Segments. Deleting can be used to make curves shorter or simplify segments by deleting control points in the mid section of a segment.

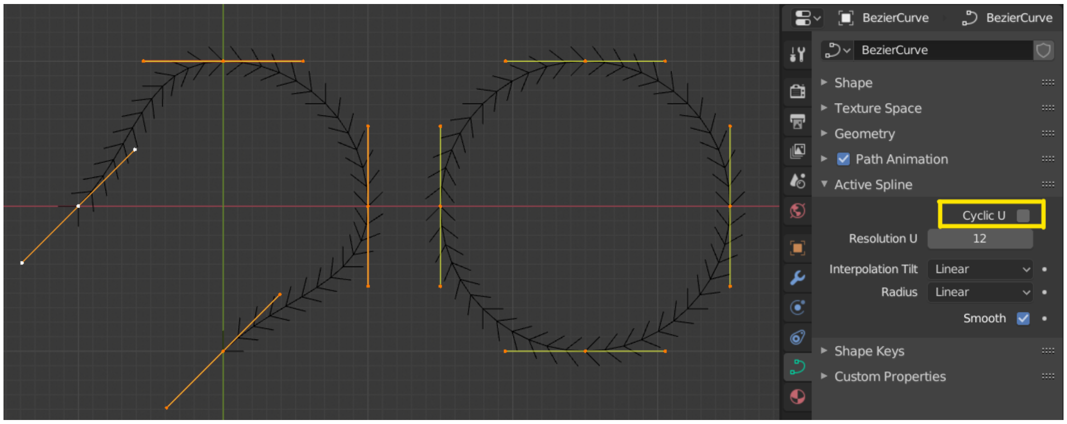
Toggle Cyclic

Reference

Mode:: Edit Mode
Menu:: *Curve ‣ Toggle Cyclic*
Shortcut:: `Alt-C`

Toggles between an open curve and closed curve (Cyclic). Only curves with at least one selected control point will be closed/open. The shape of the closing segment is based on the start and end handles for Bézier curves, and as usual on adjacent control points for NURBS. The only time a handle is adjusted after closing is if the handle is an *Auto* one. Fig. Open and Closed curves. is the same Bézier curve open and closed.

This action only works on the original starting control point or the last control point added. Deleting a segment(s) does not change how the action applies; it still operates only on the starting and last control points. This means that `Alt-C` may actually join two curves instead of closing a single curve! Remember that when a 2D curve is closed, it creates a renderable flat face.


BezierCurve
BezierCurve
BezierCurve
Shape
Texture Space
Geometry
Path Animation
Active Spline
Shape Keys
Custom Properties

Cyclic U ☐
Resolution U 12
Interpolation Tilt Linear
Radius Linear
Smooth ☑

Open and Closed curves.

Set Curve Type

Reference

Mode::	Edit Mode
Menu::	*Curves ‣ Set Curve Type*

Converts splines in a curve object between Bézier, NURBS, and Poly curves. Note, this is not a “smart” conversion, i.e. Blender does not try to keep the same shape, nor the same number of control points. For example, when converting a NURBS to a Bézier, each group of three NURBS control points become a unique Bézier one (center point and two handles).

Handles

Take handle information into account in the conversion

Control Points

Extrude Curve and Move

Reference

Mode:: Edit Mode
Menu:: *Control Points ‣ Extrude Curve and Move*
Shortcut:: `E`

Extrudes points by duplicating the selected points, which then can be moved, and connecting those points back to the original curve creating a continuous curve.

Tilt

Reference

Mode:: Edit Mode
Tool:: *Toolbar ‣ Tilt*
Shortcut:: `Ctrl-T`

This setting controls how the normals twist around each control point. The tilt will be interpolated from point to point (you can check it with the normals).

Clear Tilt

Reference

Mode:: Edit Mode
Shortcut:: `Alt-T`

You can also reset the tilt to its default value (i.e. perpendicular to the original curve plane).

Set Handle Type

Reference

Mode:: Edit Mode
Menu:: *Control Points* ▸ *Set Handle Type*
Shortcut:: V

Handle types are a property of Bézier curves and can be used to alter features of the curve. For example, switching to *Vector handles* can be used to create curves with sharp corners. Read the Bézier curves page for more details.

Segments

Subdivide

Reference

Mode::	Edit Mode
Menu::	*Curves* ‣ *Segments* ‣ *Subdivide*

Curve subdivision simply subdivides all selected segments by adding one or more control points between the selected segments.

Number of Cuts
    The number of subdivisions to perform.

Switch Direction

Reference

Mode::	Edit Mode
Menu::	*Curves* ‣ *Segments* ‣ *Switch Direction*

This tool will “reverse” the direction of any curve with at least one selected element (i.e. the start point will become the end one, and *vice versa*). This is mainly useful when using a curve as path, or using the bevel and taper options.

Properties

Hair Curves have different properties than regular Curve objects; these properties are documented below.

Attributes

The *Attributes* panel contains different hair characteristics such as the position and color of hair strands.

Use the List View to manage attributes.

See also

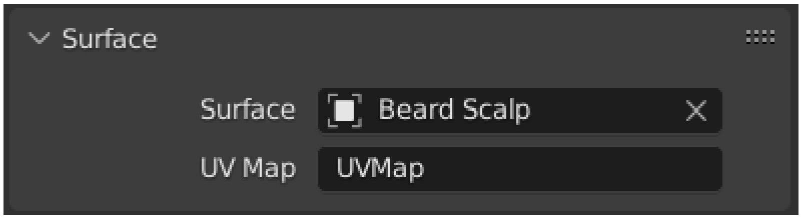
See the Attribute Reference for details on attributes.

Surface

Surface

The curve surface is an optional mesh that is used to anchor the curves, and behave as a scalp for hair grooming. When adding a new Curves object via the **Add Menu** the active object is automatically set as the surface.

To set a new surface press `Ctrl-P` and select *Object (Attach Curves to Surface)* in the *Set Parent To* pop-up menu. This option can be seen as part of the Curves settings in the Properties Editor.



Surface: Beard Scalp

UV Map: UVMap

Surface UV Map

The name of the attribute on the surface mesh used to define the attachment of each curve.

Note

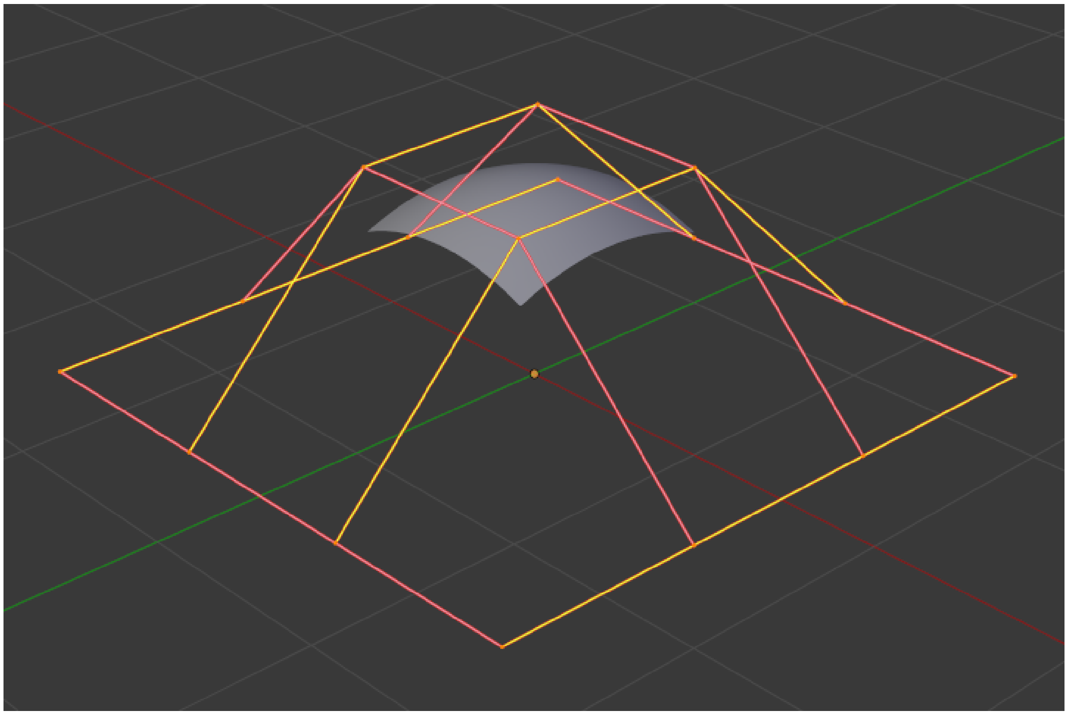
If the UV from the surface changed, run Snap to Nearest Surfaces to re-attach the curves.

Surfaces

- Introduction
    - Visualization
    - Conversion
- Toolbar
- Structure
    - Control Points, Rows and Grid
    - Weight
- Primitives
    - NURBS Curve
    - NURBS Circle
    - NURBS Surface
    - NURBS Cylinder
    - NURBS Sphere
    - NURBS Torus
- Selecting
    - Select Menu
    - Select Random
    - Checker Deselect
    - Select Linked
    - Select Similar
    - Select Control Point Row
    - Select More/Less
- Editing
    - Transform Panel
    - Surface
    - Control Points
    - Segments
- Properties
    - Shape
    - Active Spline

Introduction

Curves are 2D objects, and surfaces are their 3D extension. Note however, that in Blender, you only have NURBS surfaces, no Bézier (you have the *Bézier* knot type, though; see below), nor polygonal (but for these, you have meshes!). Even though curves and surfaces share the same object type (with texts also…), they are not the same thing; for example, you cannot have in the same object both curves and surfaces.



NURBS surface in Edit Mode.

As surfaces are 2D, they have two interpolation axes, U (as for curves) and V. It is important to understand that you can control the interpolation rules (knot, order, resolution) *independently* for each of these two dimensions (the U and V fields for all these settings, of course).

You may ask yourself “but the surface appears to be 3D, why is it only 2D?”. In order to be 3D, the object needs to have “Volume”, and a surface, even when it is closed, does not have volume; it is infinitely thin. If it had a volume the surface would have a thickness (its third dimension). Hence, it is only a 2D object, and has only two interpolation dimensions or axes or coordinates (if you know a bit of math, think of non-Euclidean geometry – well, surfaces are just non-Euclidean 2D planes…). To take a more “real-world” example, you can roll a sheet of paper to create a cylinder; well, even if it becomes a “volume”, the sheet itself will remain a (nearly…) 2D object!

In fact, surfaces are very similar to the results you get when extruding a curve.

Visualization

There is nearly no difference from NURBS curves, except that the U direction is indicated by yellow grid lines, and the V one is materialized by pink grid lines, as you can see in Fig. NURBS surface in Edit Mode..

You can hide and reveal control points just as with curves.

Conversion

As there are only NURBS surfaces, there is no “internal” conversion here.

However, there is an “external” conversion available, from surface to mesh, that only works in Object Mode. It transforms a surface object into a mesh one, using the surface resolutions in both directions to create faces, edges and vertices.

Toolbar

Surface Edit Mode tools:

Select

  Select or move.

  Select Box

    Select objects by dragging a box.

    All objects that intersect the box will be selected.

  Select Circle

    Select objects by dragging a circle. All objects that intersect the path of the circle will be selected.

  Select Lasso

    Select objects by drawing a lasso.

Cursor

  Change the location of the 3D Cursor.

Move

  Translation tool.

Rotate

  Rotation tool.

Scale

  Scale tool.

  Scale Cage

    Change the scale of an object by controlling its cage.

Transform

Tool to adjust the objects translation, rotations and scale.

Annotate

Draw free-hand annotation.

Annotate Line

Draw straight line annotation.

Annotate Polygon

Draw a polygon annotation.

Annotate Eraser

Erase previous drawn annotations.

Measure

Measure distances in the scene.

Structure

Many of the concepts from curves, especially NURBS ones, carry directly over to NURBS surfaces, such as control points, *Order*, *Weight*, *Resolution*, etc. Here we will just talk about the differences.

It is very important to understand the difference between NURBS curves and NURBS surfaces: the first one has one dimension, the latter has two. Blender internally treats NURBS surfaces and NURBS curves completely differently. There are several attributes that separate them but the most important is that a NURBS curve has a single interpolation axis (U) and a NURBS surface has two interpolation axes (U and V).

However, you can have "2D" surfaces made of curves (using the extrusion tools, or, to a lesser extent, the filling of closed 2D curves). And you can have "1D" curves made of surfaces, like a NURBS surface with only one row (either in U or V direction) of control points produces only a curve…

Visually you can tell which is which by entering Edit Mode and looking at the 3D Viewport header: either the header shows *Surface* or *Curve* as one of the menu choices. Also, you can extrude a whole NURBS surface curve to create a surface, but you cannot with a simple NURBS curve.

Control Points, Rows and Grid

Control points for NURBS surfaces are the same as for NURBS curves. However, their layout is quite constraining. The concept of "segment" disappears, replaced by "rows" and the overall "grid".

A "row" is a set of control points forming one "line" in one interpolation direction (a bit similar to edge loops for meshes). So you have "U rows" and "V rows" in a NURBS surface. The key point is that *all* rows of a given type (U or V) have the *same* number of control points. Each control point belongs to exactly one U row and one V row.

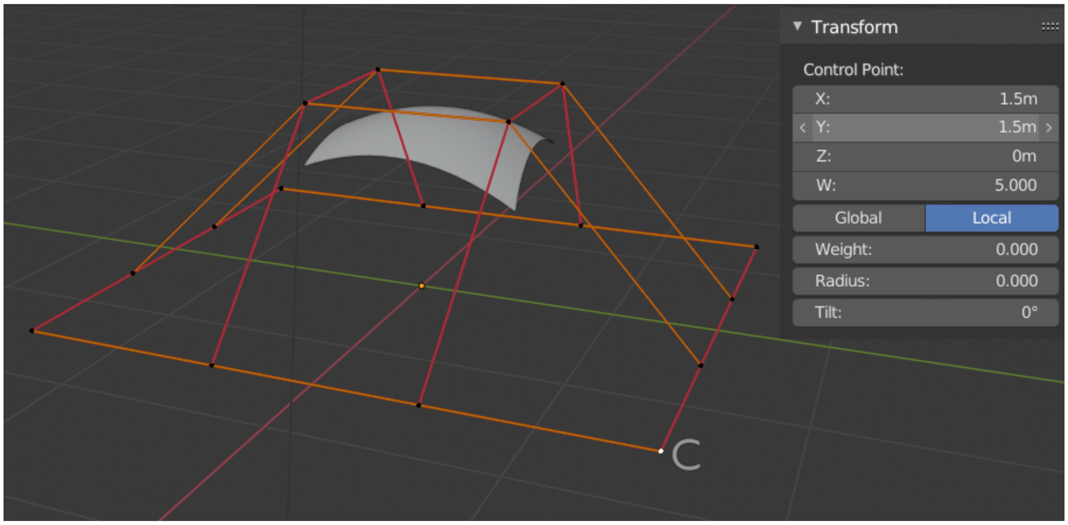
All this forms a “grid”, or “cage”, the shape of which controls the shape of the NURBS surface. A bit like a lattice…

This is very important to grasp: you cannot add a single control point to a NURBS surface; you have to add a whole U or V row at once (in practice, you will usually use the *Extrude* tool, or perhaps the *Duplicate* one, to add those…), containing exactly the same number of points as the others. This also means that you will only be able to “merge” different pieces of surfaces if at least one of their rows matches together.

Weight

Similar to NURBS Splines NURBS Surface control points have a weight property. This weight property controls how much influence the control point has on the surface. This weight should not be confused with the Goal Weight, which is used only for soft body simulations. The NURBS control point weight can be adjusted in the *W* number field of the Transform panel.

In Fig. One control point with a weight of 5. a single control point, labeled “C”, has had its *Weight* set to 5.0 while all others are at their default of 1.0. As you can see, that control point *pulls* the surface towards it.



▾ Transform

Control Point:

X: 1.5m

Y: 1.5m

Z: 0m

W: 5.000

Global | Local

Weight: 0.000

Radius: 0.000

Tilt: 0°

One control point with a weight of 5.

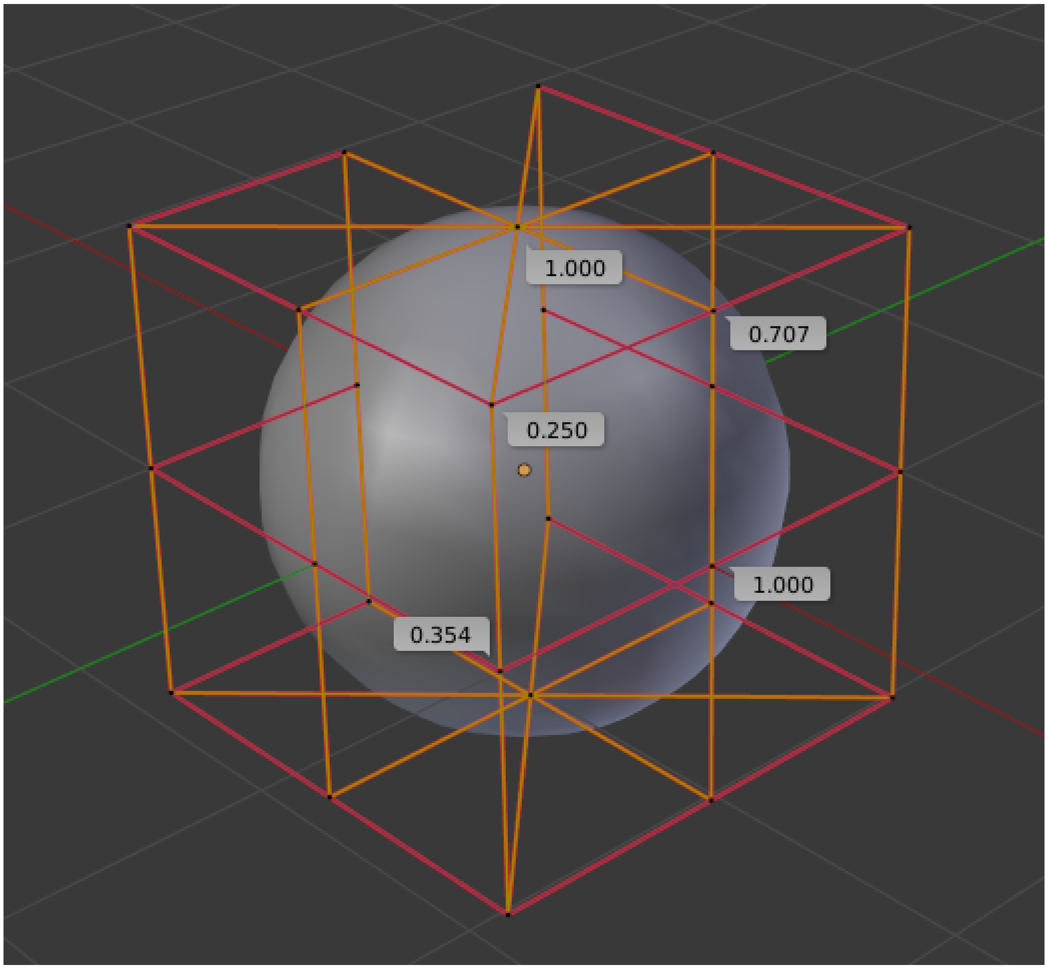
Note

If all the control points have the same *Weight* then each effectively cancels each other out. It is the difference in the weights that cause the surface to move towards or away from a control point.

Preset Weights

NURBS can create pure shapes such as circles, cylinders, and spheres (note that a Bézier circle is not a pure circle). To create pure circles, spheres, or cylinders, you must set to specific values the weights of the control points. This is not intuitive, and you should read more on NURBS before trying this.

To create a sphere with 2D surfaces, its the same principle as with a 2D circle. You will note that the four different weights needed for creating a sphere (1.0, 0.707 = sqrt(0.5), 0.354 = sqrt(2)/4, and 0.25).


1.000
0.707
0.250
1.000
0.354

A sphere surface.

Primitives

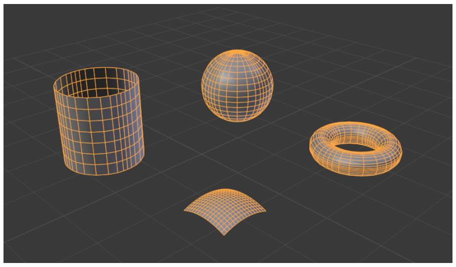
Reference

Mode::	Object Mode and Edit Mode
Menu::	*Add ‣ Curve*
Shortcut::	`Shift-A`

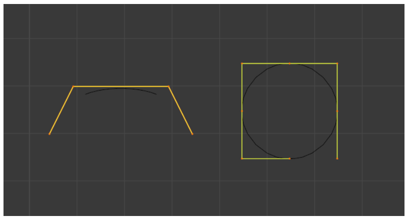
See also

When adding curves there are some common options like other Objects.

In Object/Edit Mode, the *Add Surface* menu, provides six different surface primitives:



NURBS surface primitives.



NURBS curve primitives.

NURBS Curve

Adds a generic curve of four control points forming an arc.

NURBS Circle

Adds an a closed loop of control point forming a circle. Note, a circle NURBS surface is never filled, unlike its “real” curve counterpart…

NURBS Surface

Adds a generic surface patch consisting of a 4×4 grid plane with the center grid slightly raised.

NURBS Cylinder

Adds an open end cylinder, consisting of an extruded *NURBS Circle*.

NURBS Sphere

Adds a generic sphere constructed by revolving a grid of control points about an axis.

NURBS Torus

Adds a doughnut-shaped primitive created by rotating a circle around an axis.

Selecting

This page discusses specific selecting tools for surface objects in Edit Mode. The Surface Edit also uses the general select tools used which are described in the interface section.

Surface selection in *Edit Mode* is very similar to NURBS curve selection. The basic tools are the same as with meshes, so you can select a simple control point with an `LMB`-click, add to current selection with `Shift-LMB` clicks, Border Select, and so on.

Select Menu

The *Select* menu (in the 3D Viewport header) is even simpler than for curves…

All these options have the same meaning and behavior as in Object Mode and mesh Edit Mode.

All `A`
    Select all.

None `Alt-A`
    Select none.

Inverse `Ctrl-I`
    Selects all the geometry that is not selected, and deselect currently selected components.

Box Select `B`
    Interactive box selection.

Circle Select `C`
    Interactive circle selection.

Lasso Select
    Interactive free-form selection.

Select Random
    Select random control points.

Checker Deselect
    Select every Nth control point.

Select Linked `Ctrl-L`
    Select control points that are connected to the current selection.

Select Similar `Shift-G`
    Select control points that have similar properties to the current selection.

Select Control Point Row
    Select a whole row of control points.

Select More/Less
    Select objects based on their parent child relationships.

Select Random

Reference

Mode::	Edit Mode
Menu::	*Select* ▸ *Select Random*

Select random control points.

Percent
    Selects the defined percentage of control points.

Random Seed

Seed used by the pseudo-random number generator.

Action
Controls whether the operator *Selects* or *Deselects* control points.

Checker Deselect

Reference

Mode::	Edit Mode
Menu::	*Select ‣ Checker Deselect*

This tool applies an alternating selected/deselected checker pattern. This only works if you already have more than one control point selected.

It works by changing the current selection so that only every Nth control points will remain selected, starting from the active one.

Deselected
The number of deselected elements in each pattern repetition.

Selected
The number of selected elements in each pattern repetition.

Offset
Offset from the starting point.

Select Linked

Reference

Mode::	Edit Mode
Menu::	*Select ‣ Select Linked*
Shortcut::	`L`, `Ctrl-L`

Select Linked will add to the selection the mouse cursor's nearest control point, and all the linked ones, i.e. all points belonging to the same surface.

Select Similar

Reference

Mode::	Edit Mode
Menu::	*Select* ‣ *Select Similar*
Shortcut::	`Shift-G`

Selects control points that have certain similar properties to the active one. The Adjust Last Operation panel provides several selection options:

Type

- Type
  - Selects splines that have the same spline Type i.e. Bézier, NURBS or Poly.
- Radius
  - Selects control points that have a similar Radius value.
- Weight
  - Selects all points that have a similar Weight value.
- Direction
  - Selects control points that have a similar handles direction.

Compare

For quantitative properties, this property selects the type of comparison to between the two numerical values.

Equal::	Select items with the same value as the active item's chosen property.
Greater::	Select items with a larger value as the active item's chosen property.
Less::	

Select items with a smaller value as the active item's chosen property.

Threshold
: For quantitative properties, this property controls how close the property's values have to be in the comparison.

Select Control Point Row

Reference

Mode::	Edit Mode
Menu::	*Select ‣ Control Point Row*
Shortcut::	`Shift-R`

This option works a bit like edge loop selection for meshes, inasmuch it selects a whole row of control points, based on the active (the last selected) one. The first time you press `Shift-R`, the V row passing through (containing) the active point will be added to the *current* selection. If you use again this shortcut, you will toggle between the U and V row of this point, removing *everything else* from the selection.

Select More/Less

Reference

Mode::	Edit Mode
Menu::	*Select ‣ More/Less*
Shortcut::	`Ctrl-NumpadPlus` / `Ctrl-NumpadMinus`

Expand or contract the selection based on current selected control points.

More
: For each selected control point, select **all** its linked points (i.e. two, three or four).

Less

For each selected control point, if **all** points linked to this point are selected, keep it selected. For all other selected control points, deselect them.

This implies two points:

1. First, when **all** control points of a surface are selected, nothing will happen (as for *Less*, all linked points are always selected, and of course, *More* cannot add any). Conversely, the same goes when no control point is selected.
2. Second, these tools will never “go outside” of a surface (they will never “jump” to another surface in the same object).

Editing

- Transform Panel
- Surface
    - Transform
    - Mirror
    - Snap
    - Spin
    - Add Duplicate
    - Split
    - Separate
    - Toggle Cyclic
    - Set Spline Type
    - Show/Hide
    - Cleanup
    - Delete
- Control Points
    - Extrude Curve and Move
    - Make Segment
    - Smooth
    - Hooks
    - Make Vertex Parent
- Segments
    - Subdivide
    - Switch Direction

Transform Panel

Reference

Mode::	Edit Mode
Panel::	*Sidebar ‣ Transform*

When nothing is selected, the panel is empty. When more than one control point is selected, the median values are edited and "Median" is added in front of the labels.

Control Point, Median

The first controls (X, Y, Z) show the coordinates of the selected point or handle (vertex). The last control (W), defines the weight of the selected control point or the median weight.

Space

The Space radio buttons let you choose if those coordinates are relative to the object origin (local) or the global origin (global).

Global, Local

Weight

Controls the "goal weight" of selected control points, which is used when a surface has Soft Body physics, forcing the surface to "stick" to their original positions, based on the weight.

Radius

Surface objects do not have a *Radius* property, this value has no effect.

Tilt

Surface objects do not have a *Radius* property, this value has no effect.

Surface

Surface editing has even fewer tools and options than its curve counterpart, but has many common points with it… So this page covers (or tries to cover) all the subjects, from the basics of surface editing to more advanced topics, like retopology.

Transform

Reference

Mode::	Edit Mode
Menu::	*Surface* ‣ *Transform*

A surface can be edited by transforming the locations of the control points.

Move, Rotate, Scale
: Like other elements in Blender, control points can be moved, rotated, or scaled as described in Basic Transformations.

To Sphere, Shear, Warp, Bend, Push/Pull, Warp, Randomize
: These transform tools are described in the Transformations sections.

Move/Scale Texture Space
: Like other objects, surfaces have textures spaces which can be edited.

Mirror

Reference

Mode::	Edit Mode
Menu::	*Curve* ‣ *Mirror*
Shortcut::	`Ctrl-M`

The *Mirror* tool is also available, behaving exactly as with mesh vertices.

Snap

Reference

Mode::	Edit Mode
Menu::	*Curve ‣ Snap*
Shortcut::	`Shift-S`

Mesh snapping also works with control points, except for within itself (other components of the active spline). Snapping works with 2D surfaces but points will be constrained to the local XY axes.

Spin

Reference

Mode::	Edit Mode
Menu::	*Surface ‣ Spin*

This tool is a bit similar to its mesh counterpart but with less control and options (in fact, there is none!).

It only works on selected “surfaces” made of *one U row* (and not with one V row), so-called “surface curves”, by “extruding” this “cross section” in a square pattern. While automatically adjusting the weights of control points to get a perfect circular extrusion (this also implies closing the surface along the V axis), following exactly the same principle as for the *NURBS Tube* or *NURBS Torus* primitives.

Add Duplicate

Reference

Mode:: Edit Mode
Menu:: *Surface ‣ Add Duplicate*
Shortcut:: `Shift-D`

Similar as with meshes and curves, this tool duplicates the selection. The copy is selected and placed in move mode, so you can move it to another place.

However, with surfaces there are some selections that cannot be duplicated, in which case they will just be placed in move mode… In fact, only selections forming a *single* valid sub-grid are copyable; let us see this in practice:

- You can copy a single control point. From it, you will be able to “extrude” a “surface curve” along the U axis, and then extrude this unique U row along the V axis to create a real new surface.
- You can copy a single continuous part of a row (or a whole row, of course). This will give you a new *U row*, even if you selected (part of) a V row!
- You can copy a single whole sub-grid.

Note

Trying to duplicate several valid “sub-grids” (even being single points) at once will not work; you will have to do it one after the other…

Split

Reference

Mode:: Edit Mode
Menu:: *Surface ‣ Split*
Shortcut:: `Y`

The *Split* operator splits a selected segment of a surface from the rest of the surface. This segment can then be moved or altered without affecting the other surface. If a single control point is selected the *Split* operator will create a new singular loose control point; leaving the previously selected control point attached to the rest of the surface.

Separate

Reference

Mode::	Edit Mode
Menu::	*Surface* ‣ *Separate*
Shortcut::	`P`

Surface objects that are made of multiple distinct parts can be separated into their own objects by selecting the desired segments and using *Separate*. Note, if there is only one surface in a surface object, *Separate* will create a new surface object with no control points.

Toggle Cyclic

Reference

Mode::	Edit Mode
Menu::	*Surface* ‣ *Toggle Cyclic*
Shortcut::	`Alt-C`

As in curves, surfaces can be closed (cyclic) or open. However, as surfaces are 2D, you can control this property independently along the U and V axes.

To toggle the cyclic property of a surface along one axis, use *Toggle Cyclic* and choose either *Cyclic U* or *Cyclic V* from the pop-up menu. The corresponding surface's outer edges will join together to form a "closed" surface.

Note

Inner and Outer

Surfaces have an “inner” and “outer” face, the first being black whereas the latter is correctly shaded. When you close a surface in one or two directions, you might get an entirely black object! In this case, just Switch Direction of the surface.

Set Spline Type

Reference

Mode::	Edit Mode
Menu::	*Surface ‣ Set Spline Type*

This feature only works for Curves.

Show/Hide

Reference

Mode::	Edit Mode
Menu::	*Curve ‣ Show/Hide*
Shortcut::	`Alt-H`, `H`, `Shift-H`

When in *Edit Mode*, you can hide and reveal elements from the display. You can only show or hide control points, as segments are always shown, unless all control points of the connected surface are hidden, in which case the surface is fully hidden.

See also

See Show/Hide in *Object Mode*.

Cleanup

Reference

Mode::	Edit Mode
Menu::	*Surface ‣ Cleanup*

This feature only works for Curves.

Delete

Reference

Mode::	Edit Mode
Menu::	*Surface ‣ Delete*
Shortcut::	`X`, `Delete`

The selection must abide by the following rules:

- Whole rows, and only whole rows must be selected.
- Only rows along the same axis must be selected (i.e. you cannot delete both U and V rows at the same time).

Also remember that NURBS order cannot be higher than its number of control points in a given axis, so it might decrease when you delete some control points… Of course, when only one row remains, the surface becomes a "surface curve"; when only one point remains, there is no more visible surface; and when all points are deleted, the surface itself is deleted.

Vertices
: This will delete the selected rows, *without* breaking the surface (i.e. the adjacent rows will be directly linked, joined, once the intermediary ones

are deleted). Remember that NURBS order cannot be higher than its number of control points, so it might decrease when you delete some control point. Of course, when only one point remains, there is no more visible curve, and when all points are deleted, the curve itself is deleted.

Segment

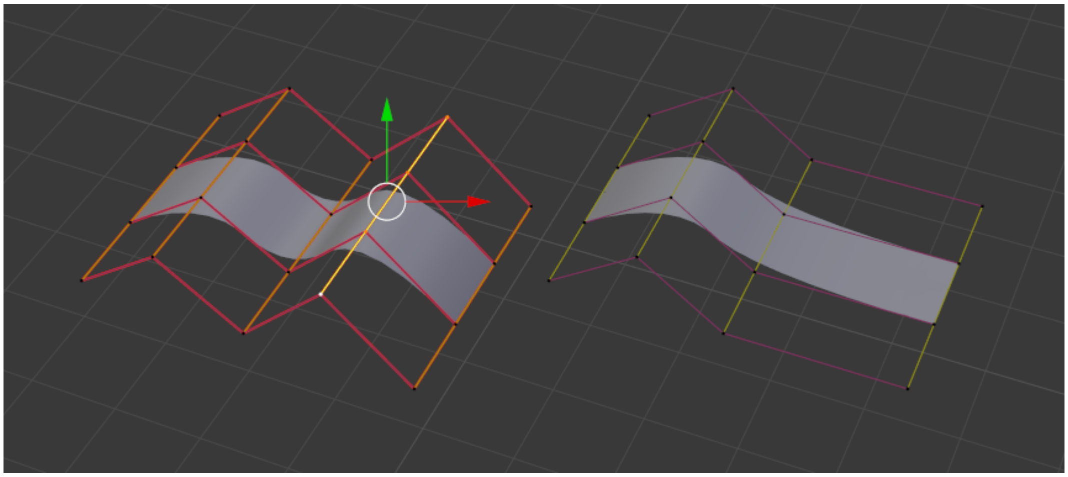
Deletes the segment that connects the selected control points and disconnects them.

Dissolve Vertices `Ctrl-X`

This feature only works for Curves.

Example

In the image below (left), a row of control points has been selected by initially selecting the one control point and using Select Control Point Row to select the remaining control points. Then, using Delete *Vertices*, the selected row of control points is erased, resulting in the image below (right).



Before and after.

Control Points

Extrude Curve and Move

Reference

Mode:: Edit Mode
Menu:: *Surface ‣ Extrude Curve and Move*
Shortcut:: `E`

Unlike meshes or curves, you cannot generally directly add new control points to a surface, as you can only extend a surface by adding a whole U or V row at once. The only exception is when working on a NURBS surface curve, i.e. a surface with only one control point on each U or V row. In this special case, all works exactly as with curves.

Most of the time, only extrusion is available. As usual, once the tool is activated the extrusion happens immediately and you are placed into *select mode*, ready to drag the new extruded surface to its destination.

There are two things very important to understand:

1. Surfaces are *2D* objects. So you cannot extrude anything *inside* a surface (e.g. “inner” row); it would not make any sense!
2. The control “grid” *must* remain “squarish”, which means that you can only extrude a whole row, not parts of rows here and there…

To summarize, the *Extrude* tool will only work, when one and only one whole border row is selected, otherwise nothing happens.

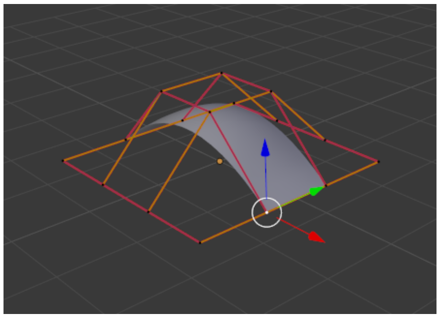
Note

As for curves, you cannot create a new surface in your object out of nowhere. However, unlike for curves, there is no “cut” option allowing you to separate a surface into several parts, so you only can create a new surface by Duplicating an existing one, or adding a new one with the *Add* menu.

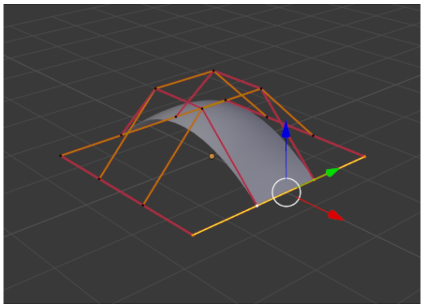
Examples

Images Fig. Selecting control point. to Fig. Extruding. show a typical extrusion along the side of a surface.

In Fig. Selecting control point. and Select Control Point Row., a border row of control points were highlighted by selecting a single control point, and then using Select Control Point Row to select the rest of the control points.

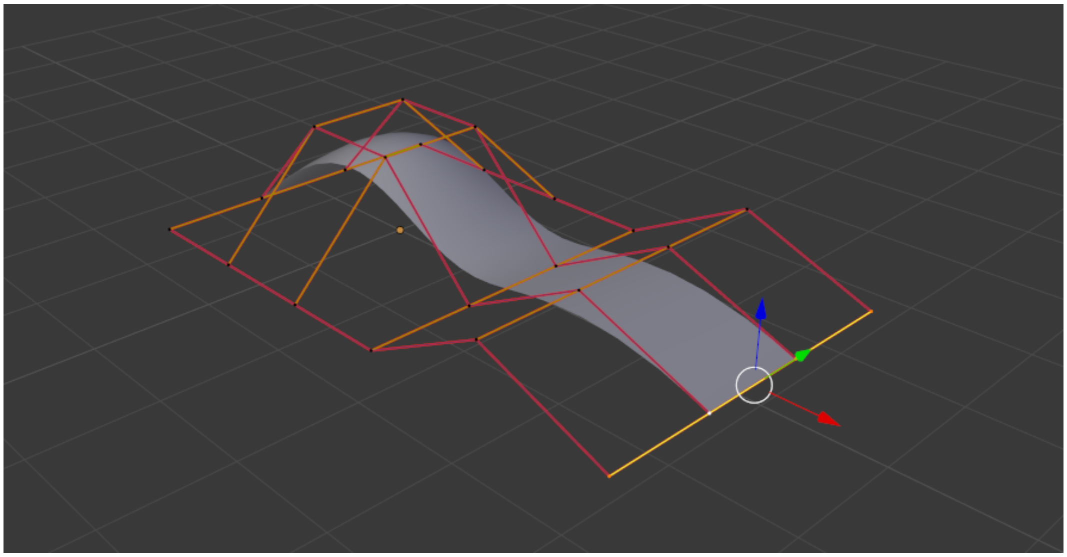


Selecting control point.



Select Control Point Row.

The edge is then extruded as shown in Fig. Extruding.. Notice how the mesh has bunched up next to the highlighted edge. That is because the *new* extruded surface section is bunched up there as well.



Extruding.

By moving the new section away from the area, the surface begins to "unbunch".

You can continue this process of extruding or adding new surface sections until you have reached the final shape for your model.

Make Segment

Reference

Mode:: Edit Mode
Menu:: *Surface* ▸ *Make Segment*
Shortcut:: `F`

Just like curves, merging two surfaces requires that a single edge, a border row of control points, from two separate surfaces is selected. This means that the surfaces must be part of the same object. For example, you cannot join two surfaces while in *Object Mode* – but you can of course, as with any objects of the same type, join two or more *Surface* objects – they just will not be "linked" or merged in a single one.

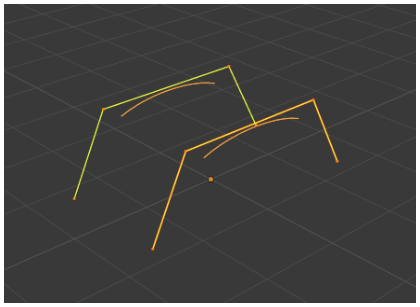
This tool is equivalent to creating edges or faces for meshes (hence its shortcut). The selection must contain only border rows of the same resolution (with the same number of control points), else Blender will try to do its best to guess what to merge with what, or the merge will fail (either silently, or stating that `Resolution does not match` if rows with different number of points are selected, or that there is `Too few selections to merge` if you only selected points in one surface…). To select control points of different surfaces, in the same object, you must use either box select or circle select; `Ctrl-LMB` will not work.

So to avoid problems, you should always only select border rows with the same number of points… Note that you can join a border U row of one surface with a border V row of another one, Blender will automatically "invert" the axis of one surface for them to match correctly.

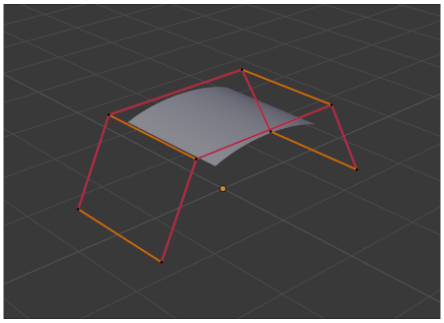
NURBS surface curves are often used to create objects like hulls, as they define cross sections all along the object, and you just have to "skin" them as described above to get a nice, smooth and harmonious shape.

Examples

Fig. Joining ready. is an example of two NURBS surface curves, **not** NURBS curves, in *Edit Mode*, ready to be joined. Fig. Joining complete. is the result of joining the two curves.



Joining ready.



Joining complete.

Smooth

Reference

Mode::	Edit Mode
Menu::	*Surface ‣ Control Points ‣ Smooth*

Iteratively smooths the selected control points by reducing the distance between neighboring control points.

Hooks

Reference

Mode::	Edit Mode
Menu::	*Surface ‣ Control Points ‣ Hooks*
Shortcut::	`Ctrl-H`

Hooks can be added to control one or more points with other objects.

Make Vertex Parent

Reference

Mode::	Edit Mode
Menu::	*Surface ‣ Control Points ‣ Make Vertex Parent*
Shortcut::	`Ctrl-P`

You can make other selected objects children of one or three control points, as with mesh objects.

To select a mesh (that is in view) while editing a surface, `Ctrl-P` click on it. Select either one or three control points, then `Ctrl-LMB` the object and use `Ctrl-P` to make a vertex parent. Selecting three control points will make the child follow the median point between the three vertices. An alternative would be to use a Child Of constraint. See also the Curve modifier.

Segments

Subdivide

Reference

Mode::	Edit Mode
Menu::	*Surface ‣ Segments ‣ Subdivide*

The *Subdivision* operator simply subdivides all selected segments by adding one or more control points between the selected segments. Selected grids will be split into four smaller ones.

If used on a 1D surface (a “surface curve”), this tool works exactly as with curves.

Number of Cuts
    The number of subdivisions to perform.

Switch Direction

Reference

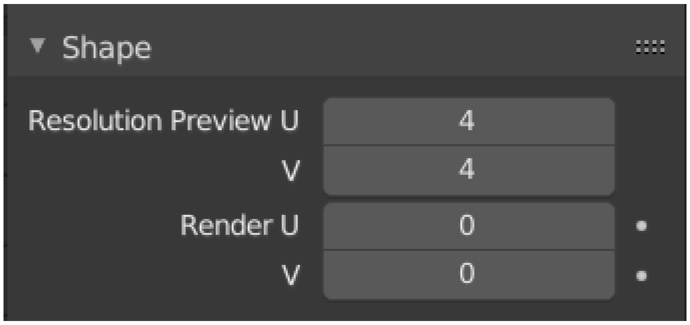
Mode::	Edit Mode
Menu::	*Surface ‣ Segments ‣ Switch Direction*

This tool will “reverse” the direction of any curve with at least one selected element (i.e. the start point will become the end one, and *vice versa*). Mainly useful when using a curve as path, or the bevel and taper options…

Properties

- Shape
- Active Spline

Shape



Shape

Resolution Preview U 4

V 4

Render U 0

V 0

Shape panel.

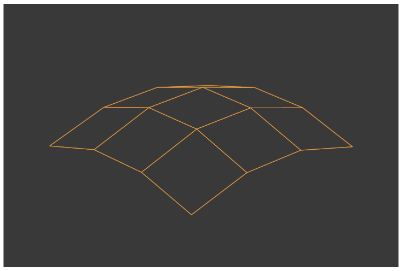
Resolution Preview U/V

Resolution to use in the 3D Viewport.

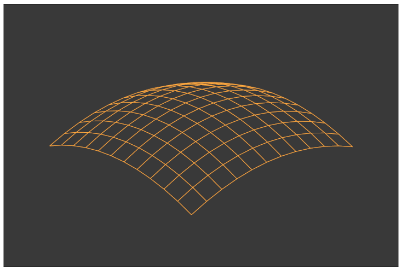
Render U/V

Just like NURBS curves, *Resolution* controls the detail of the surface. The higher the *Resolution* the more detailed and smoother the surface is. The lower the *Resolution* the rougher the surface. However, here you have two resolution settings, one for each interpolation axis (U and V).

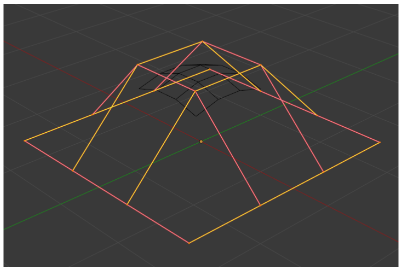
You can adjust the resolution separately for both preview and render, to not slow things down in the viewport, but still get good render results.



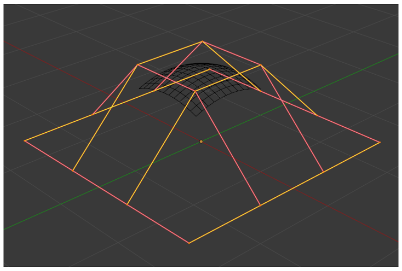
Resolution 1×1.



Resolution 3×3.



Resolution of 1 for both U and V.



Resolution of 3 for both U and V.

See also

The panels of the *Curve and Surface* tab are the same as for curves, just with fewer options…

Active Spline

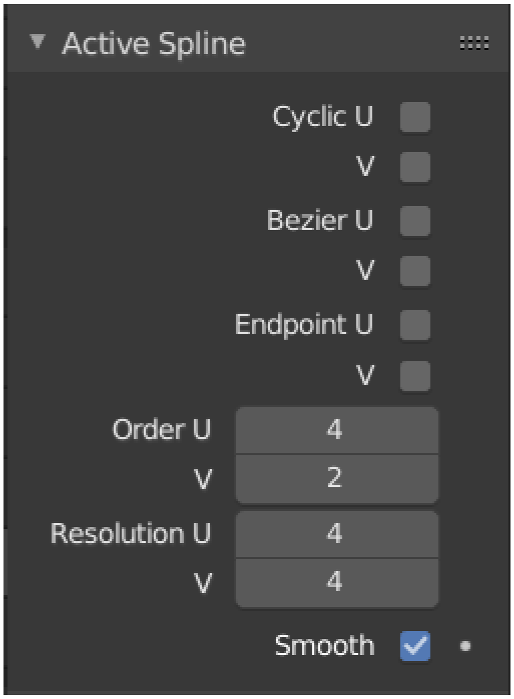
Reference

Mode::	Edit Mode
Menu::	*Properties* ▸ *Curve* ▸ *Active Spline*

See also

Active Spline for curves.

The *Active Spline* panel is used in Edit Mode to control properties of the currently selected spline.



Cyclic U ☐
V ☐
Bezier U ☐
V ☐
Endpoint U ☐
V ☐
Order U 4
V 2
Resolution U 4
V 4
Smooth ☑

Active Spline panel.

Cyclic U/V

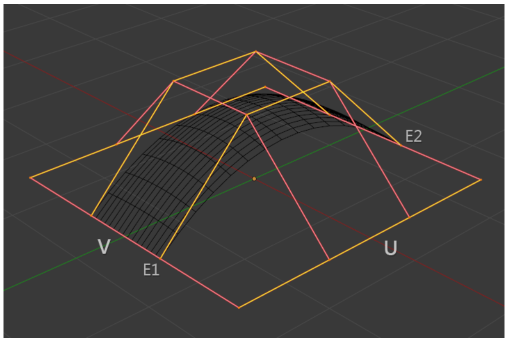
Like curves, surfaces can be closed (cyclical) or open, independently in both directions, allowing you to easily create a tube, torus or sphere shape, and they can be viewed as “solids” in *Edit Mode*. This can be set per interpolation axis.

Bézier U

Makes the surface act like a Bézier curve. The control points act like *Free* handles of a Bézier curve. Depending on the *Order*, 3 or 4 control points form one spline segment. This can be set per interpolation axis.

Endpoint U/V

Makes the surface contact the end control points. This can be set per interpolation axis.



Endpoint U.

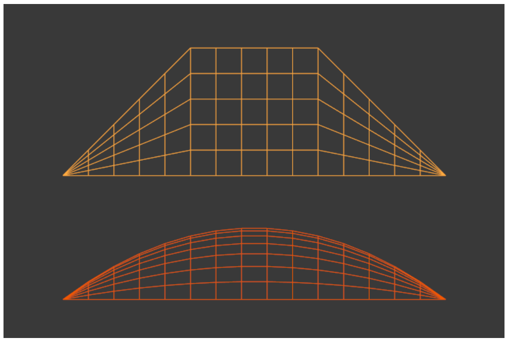
In the image below, the U interpolation axis is labeled as “U” and the V interpolation axis is labeled as “V”. The U’s interpolation axis has been set to *Endpoint* and as such the surface now extends to the outer edges from E1 to E2 along the U interpolation axis.

To cause the surface to extend to all edges, *Endpoint* would be set for the V’s axis as well.

Order U/V

This property is the same as with [NURBS Curves](); it specifies how much the control points are taken into account for calculating the curve of the surface shape. For high Orders 1 the surface pulls away from the control points, creating a smoother surface by assuming that the

Resolution U/V is high enough. For lowest Orders 2 the surface follows the control points, creating a surface that tends to follow the grid cage.



Order 2 and Order 4 surface.

For illustration purposes, in both Fig. Order 2 and Order 4 surface., the knot vectors were set to *Endpoint*, causing the surface to extend to all edges.

You can set independently the order for each interpolation axis, and like curves, it **cannot** be lower than 2, and higher than 6 or the number of control points on the relevant axis.

Resolution U/V

Alters the resolution of each segment by changing the number of subdivisions. This can be set per interpolation axis.

Smooth

Use Smooth Shading for any 3D geometry.

Metaball

- Introduction
  - Visualization
- Toolbar
- Structure
  - Technical Details
  - Type
- Primitives
  - Options
- Editing
  - Deleting Elements
  - Conversion
  - Object Families
  - Examples
- Properties
  - Metaball
  - Active Element

Introduction

Metaball objects (short meta) are *implicit surfaces*, meaning that they are *not explicitly* defined by vertices (as meshes are) or control points (as surfaces are): they exist *procedurally*. Meta objects are literally mathematical formulas that are calculated on-the-fly by Blender.

A very distinct visual characteristic of metas is that they are fluid *mercurial*, or *clay-like* forms that have a "rounded" shape. Furthermore, when two meta objects get close to one another, they begin to interact with one another. They "blend" or "merge", as water droplets do, especially in zero-g (which, by the way, makes them very handy for modeling streams of water when you do not want to do a fluid simulation). If they subsequently move away from one another, they restore their original shape.

Each of these is defined by its own underlying mathematical structure, and you can at any time switch between them using the *Active Element* panel.

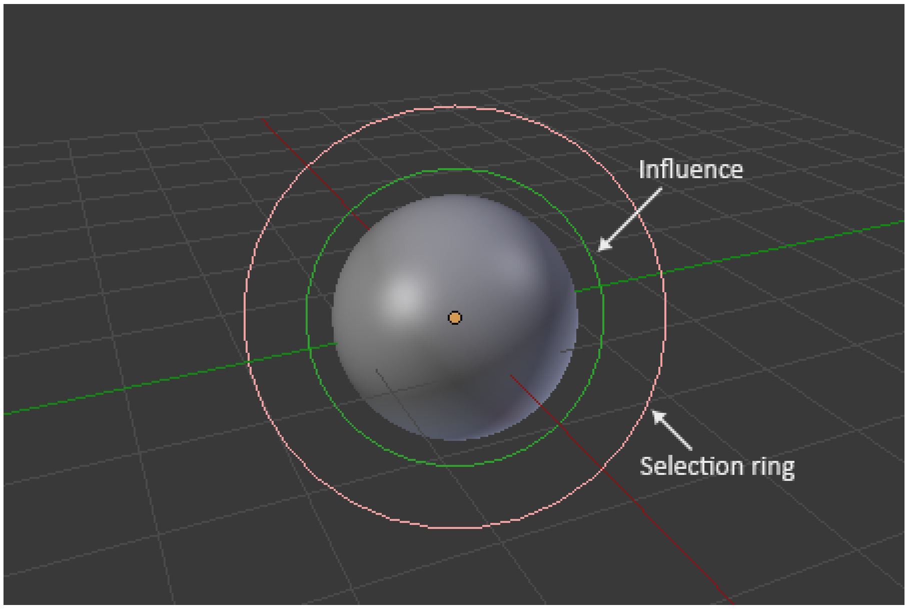
Typically *Meta* objects are used for special effects or as a basis for modeling. For example, you could use a collection of metas to form the initial shape of your model and then convert it to a mesh for further modeling or sculpting. Meta objects are also very efficient for ray tracing.

Warning

Names of *Meta* objects are very important, as they define families, and only objects within a same family interact with each other. Unlike other object types, even edition (transformations) in Object Mode will affect the generated geometry within the edited families.

Visualization

In Object Mode, the calculated mesh is shown, along with a black “selection ring”.



Meta Ball in Edit Mode.

In Edit Mode (Fig. Meta Ball in Edit Mode.), a meta is displayed as a mesh (either shaded or as black wireframe, but without any vertex of course), with two colored circles: a red one for selection (pink when selected), and a green one for a direct control of the meta’s stiffness (light green when active). Note that except for the scale transformation, having the green circle highlighted is equivalent to having the red one.

Toolbar

Metaball Edit Mode tools:

Tweak
: Select or move.

  Select Box
  : Select objects by dragging a box. All objects that intersect the box will be selected.

  Select Circle
  : Select objects by dragging a circle. All objects that intersect the path of the circle will be selected.

  Select Lasso
  : Select objects by drawing a lasso.

Cursor
: Change the location of the 3D Cursor.

Move
: Translation tool.

Rotate
: Rotation tool.

Scale
: Scale tool.

  Scale Cage
  : Change the scale of an object by controlling its cage.

Transform
: Tool to adjust the objects translation, rotations and scale.

Annotate

Draw free-hand annotation.

Annotate Line

Draw straight line annotation.

Annotate Polygon

Draw a polygon annotation.

Annotate Eraser

Erase previous drawn annotations.

Measure

Measure distances in the scene.

Shear

Shear selected items along a defined axis.

Structure

Technical Details

A more formal definition of a meta object can be given as a *directing structure* which can be seen as the source of a static field. The field can be either positive or negative and hence the field generated by neighboring directing structures can attract or repel.

The implicit surface is defined as the surface where the 3D field generated by all the directing structures assume a given value. For example a meta ball, whose directing structure is a point, generates an isotropic (i.e. identical in all directions) field around it and the surfaces at constant field value are spheres centered at the directing point.

Meta objects are nothing more than mathematical formula that perform logical operations on one another (AND, OR), and that can be added and subtracted from each other. This method is also called *Constructive Solid Geometry* (CSG). Because of its mathematical nature, CSG uses little memory, but requires lots of processing power to compute.

See also

The Wikipedia page about metaballs.

Type

Reference

Mode::	Edit Mode
Panel::	*Sidebar region* ▸ *Transform panel* ▸ *Type*, *Metaball tab* ▸ *Active Element panel* ▸ *Type*

Blender has five types of metas, each determined by its underlying (or directing) structure.

In Edit Mode, you can change this structure, either using the relevant buttons in the *Active Element* panel, or the selector in the *Transform* panel in the Sidebar region. Depending on the structure, you might have additional parameters, located in both *Transform* panel and *Active Element* panel.

Ball (point, zero-dimensional structure)

This is the simplest meta, without any additional setting. As it is just a point, it generates an isotropic field, yielding a spherical surface (this is why it is called *Meta Ball* or *Ball* in Blender).

Capsule (straight line, one-dimensional structure)

This is a meta which surface is generated by the field produced by a straight line of a given length. This gives a cylindrical surface, with rounded closed ends.

Size X

The length of the line (and hence, of the capsule).

Plane (rectangular plane, two-dimensional structure)

This is a meta which surface is generated by the field produced by a rectangular plane. This gives a parallelepipedal surface, with a fixed thickness, and rounded borders.

Size X/Y

The length and width of the rectangle.

Ellipsoid (ellipsoidal volume, three-dimensional structure)

This is a meta which surface is generated by the field produced by an ellipsoidal volume. This gives an ellipsoidal surface.

Size X/Y/Z

The length, width and height of the ellipsoid.

Cube (parallelepipedal volume, three-dimensional structure)

This is a meta which surface is generated by the field produced by a parallelepipedal volume. This gives a parallelepipedal surface, with rounded edges.

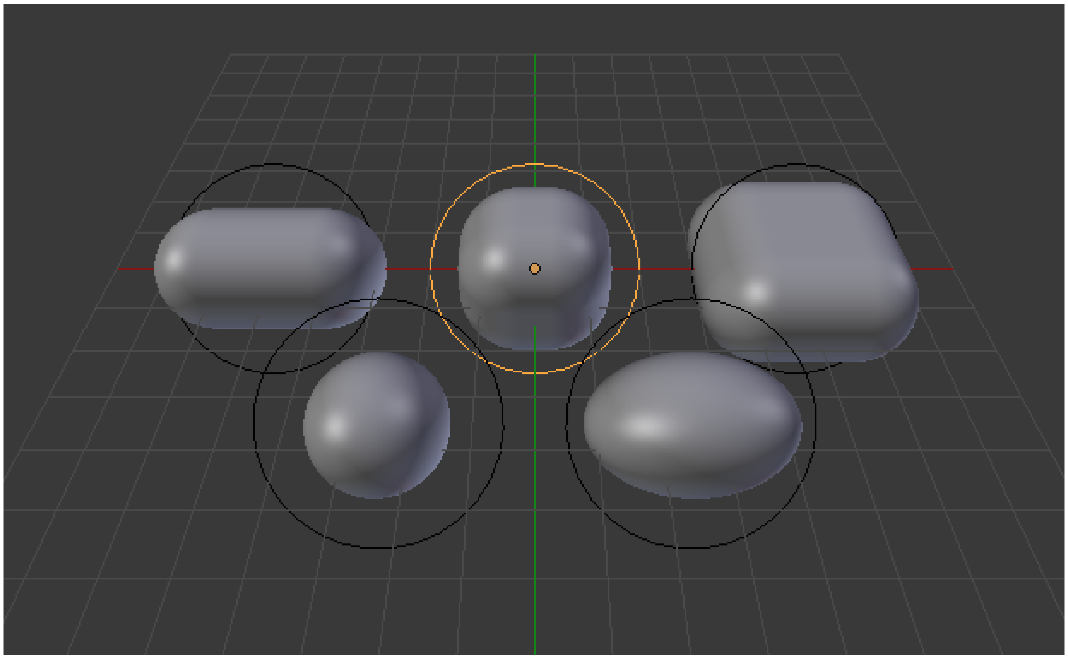
Size X/Y/Z
    The length, width and height of the parallelepiped.

Primitives

Reference

Mode::	Object Mode and Edit Mode
Menu::	*Add* ‣ *Metaball*
Shortcut::	`Shift-A`

There are five predefined metaball "primitives" (or configurations) available in the *Add* ‣ *Metaball* submenu:



The five Metaball primitives.

Options

Primitive

Ball

Adds a meta with a point underlying structure.

Capsule
: Adds a meta with a line segment underlying structure.

Plane
: Adds a meta with a planar underlying structure.

Ellipsoid
: Adds a meta with an ellipsoidal underlying structure.

Cube
: Adds a meta with a volumetric cubic underlying structure.

See also

A more detailed explanation of each primitive in the Structure page.

Radius, Align to View, Location, Rotation

See Common Object Options.

Editing

In addition to having several meta objects in a same family, you can also have several meta primitives in a single object (just add some more while in Edit Mode). Each will be an element, with its own shape, editing rings (in the viewport), and settings.

Deleting Elements

Reference

Shortcut:: `X`, `Delete`

You can only delete the active element, no fancy options here.

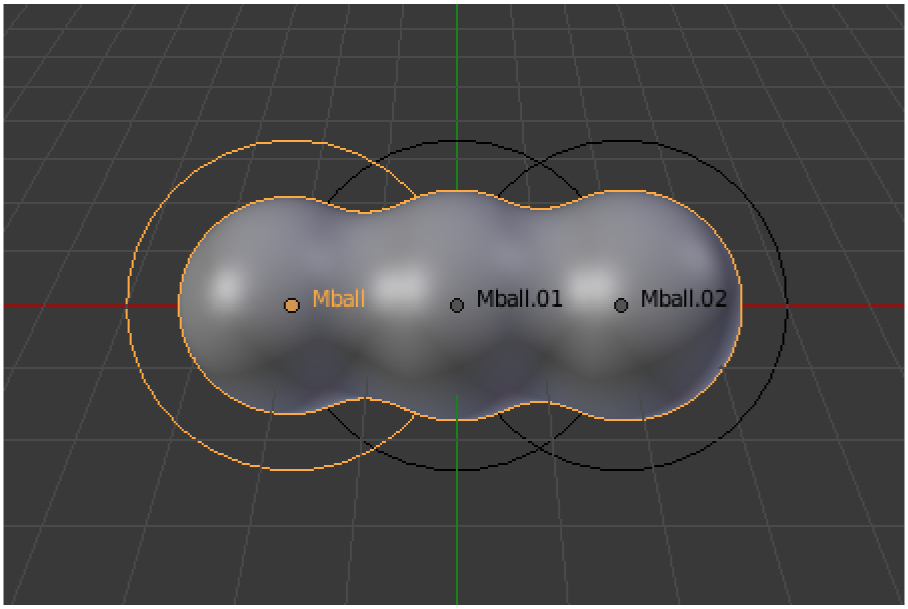
Conversion

To convert the meta to a real mesh, use Convert in Object Mode.

Object Families

A "family" is a way to regroup several meta objects, producing something very similar to having several metas inside the same object.

It is defined by the left part of an object's name (the one before the first dot). Remember, an object's name is the one in the *Object Name* field, in most panels, **not** the *Metaball Name* field, which is the meta data-block's name… For example, the *family* part of "MetaPlane.001" is `MetaPlane`. Each meta object in the same "family" is associated with one another as discussed below.



Metaball family.

Families of metas are controlled by a *base* meta object which is identified by an object name **without** a dot in it. For example, if we have three metas called `MetaThing`, `MetaThing.001`, `MetaThing.round`, the *base* meta object would be `MetaThing`.

The *base* meta object determines the basis, the resolution, the threshold, *and* the transformations. It also has the material and texture area. In a way, the *base* meta is the "owner" of the other metas in the family (i.e. it is as if the other metas were "included" or joined into the base one).

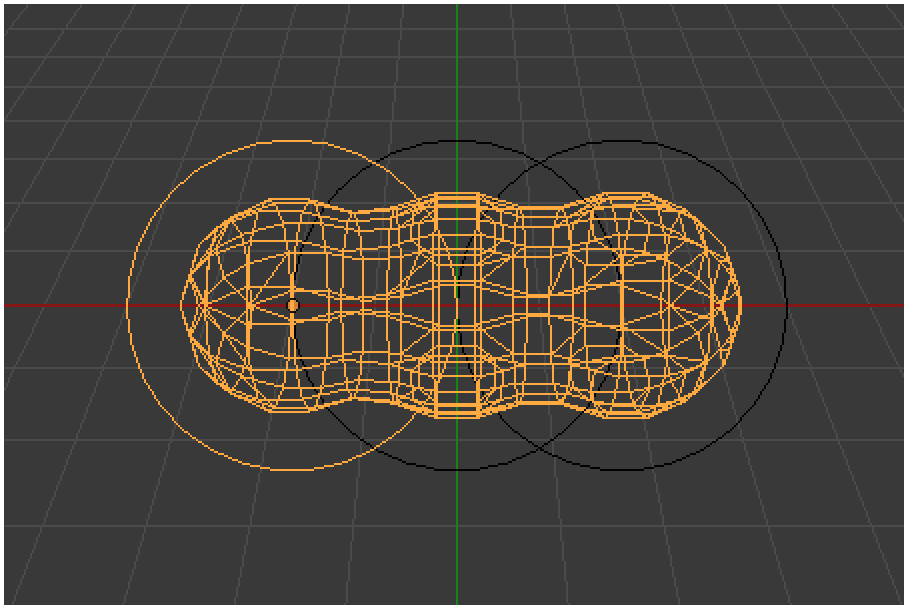
Hint

When working with multiple scenes, take care naming your meta objects so the *base* is always in the same scene as other metas.

Failing to do so will give confusing behaviors (like invisible meta objects).

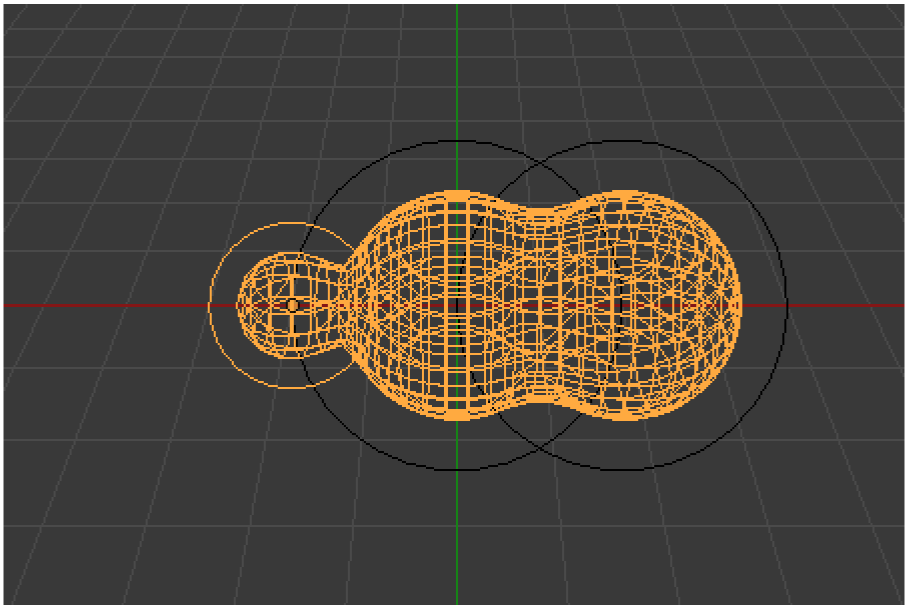
Examples

Fig. Meta ball base. shows the *base* meta labeled “B”. The other two *Meta* objects are *children*. Children’s selection rings are always black, while the group’s mesh is orange. Because the metas are grouped, they form a unified mesh which can always be selected by selecting the mesh of any meta in the group.



Meta ball base.

For example, in Fig. Meta ball base., only the lower sphere (the parent) has been selected, and you see that both the parent’s mesh *and* all of the children’s meshes are now highlighted.



Scaling the “base”.

The *base* meta object controls the *polygonalization* (mesh structure) for the group, and as such, also controls the polygonalization for the children (non-base) metas. If we transform the *base* meta, the children’s polygonalization changes. However, if we transform the children, the polygonalization remains unchanged.

Hint

This discussion of “polygonalization” does *not* mean that the various meshes do not deform towards or away from each other (meta objects always influence one another in the usual way, within a same family).

Rather, it means that the underlying mesh structure changes only when the *base* object transforms. For example, if you scale the *base*, the children’s mesh structure changes.

In Fig. Scaling the “base”., the *base* has been scaled down, which has the effect of scaling the mesh structure of each of the children. As you can see, the children’s mesh resolution has increased, while the *base* decreased. The children did *not* change size!

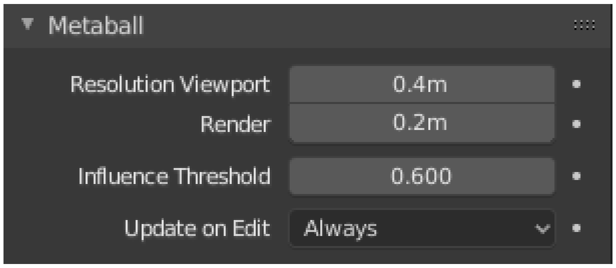
Properties

All meta objects of a same family in a scene interact with each other. The settings in the *Metaball* section apply to all meta objects of the active family. In Edit Mode, the *Active Element* panel is shown for editing individual metaball elements.

Metaball

Reference

Mode:: Object and Edit Mode
Panel:: *Properties* ▸ *Metaball* ▸ *Metaball*



Resolution Viewport 0.4m
Render 0.2m
Influence Threshold 0.600
Update on Edit Always

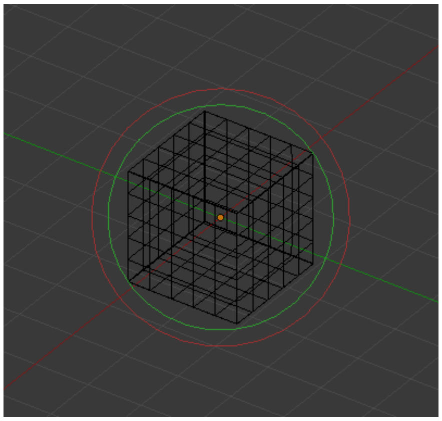
Family meta properties.

Resolution Viewport
: Controls the resolution of the resultant mesh as generated by the *Meta* objects. The 3D Viewport resolution of the generated mesh; finest to coarsest.

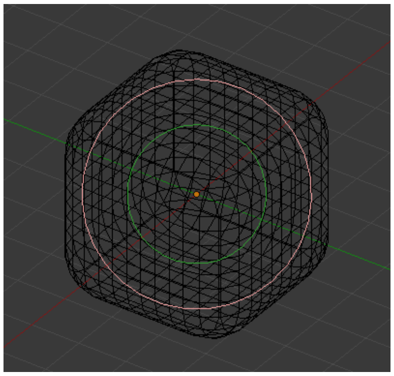
Render
: The rendered resolution of the generated mesh; finest to coarsest.

Tip

One way to see the underlying mathematical structure is to lower the *Resolution*, increase the *Threshold* and set the *Stiffness* (see below) a fraction above the *Threshold*. Fig. Underlying structure. is a meta cube with the above mentioned configuration applied as follows: *Resolution* of 0.410, *Threshold* of 5.0 and *Stiffness* a fraction above at 5.01.



Underlying structure.



Meta cube shape.

You can clearly see the underlying cubic structure that gives the meta cube its shape.

Influence Threshold

Defines how much a meta's surface "influences" other metas. It controls the *field level* at which the surface is computed. The setting is global to a group of *Meta* objects. As the threshold increases, so does the influence that each meta has on each other.

There are two types of influence: *positive* or *negative*.

Update on Edit

While transforming metas (move, scale, etc.), you have four "modes" of visualization.

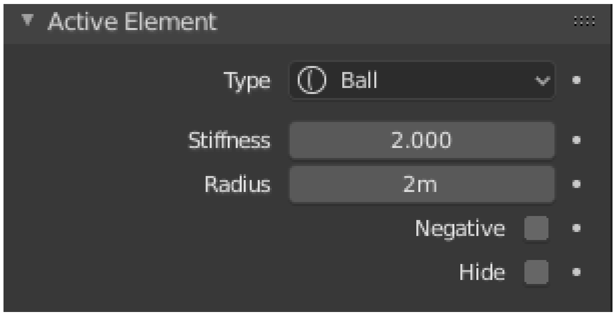
This should help you if you experience difficulties (metas are quite computationally intensive…), but with modern computers, this should not happen, unless you use many metas, or very high resolutions…

Always::	Fully display the meta during transformations.
Half::	During transformations, display the meta at half its *Viewport* resolution.
Fast::	Do not display meta during transformations.
Never::	Never show meta mesh (not a very recommended option, as the meta is only visible at render time!).

Active Element

Reference

Mode::	Edit Mode
Panel::	*Properties* ‣ *Metaball* ‣ *Active Element*



Type: Ball
Stiffness: 2.000
Radius: 2m
Negative ☐
Hide ☐

Active Element panel.

These settings apply only to the selected metaball element.

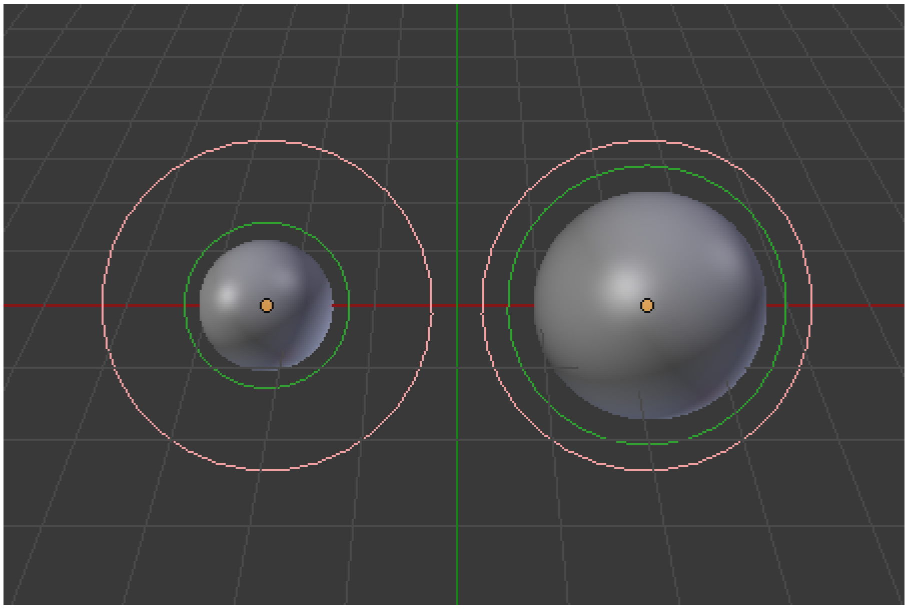
Type

Changes the primitive shape of the meta object.

Stiffness

Controls the influence range for individual metaball elements, unlike *Influence Threshold* which controls the influence for the entire meta family. This essentially defines how sensitive a meta is to being affected by other metas. With a low stiffness, the meta will begin to deform from further away. A higher value means the meta needs to be close to another one to begin merging. The *Stiffness* is visualized by the *green ring* and can be selected and scaled to also change the *Stiffness* value.

To be visible, the *Stiffness* must be slightly larger than the *Threshold* value.



The left meta ball, has a smaller *Stiffness* value than the right one.

Radius

Controls the physical size of the metaball. This works the same as scaling the metaball in Object Mode. The *Radius* is visualized by the *white ring* and can be selected and scaled to also change the *Radius* value.

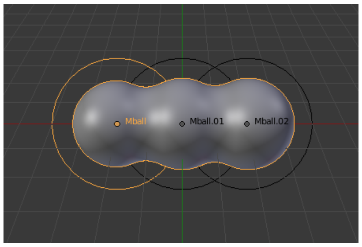
Negative

Controls whether the influence is *positive* or *negative*.

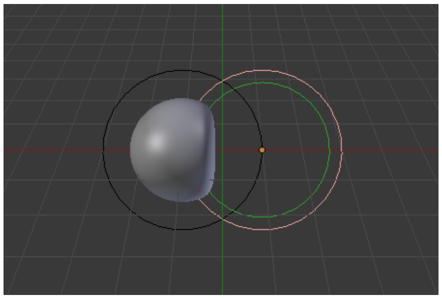
A *positive* influence is defined as an attraction, meaning that the meshes will stretch towards each other as the *rings of influence* intersect. The opposite effect would be a *negative* influence where the objects repel each other.

Note

If a metaball has *Negative* influence the meta is not visible in the 3D Viewport, only the surrounding circles are shown.



Positive influence of three metaballs.



Negative influence of a meta ball; the first is negative and the second positive.

Hide

As in Show/Hide in Object Mode, you can hide the selected meta(s), and then reveal what was hidden. This is very handy for cleaning your views up a bit.

Note

- Hiding a meta does not *only* hide it, but also disables it from the meta computation, which will affect the final geometry.
- The two red and green rings always remain visible in Edit Mode, as well as the select circle in Object Mode.

Text

- Introduction
- Selecting
- Editing
  - Cut
  - Copy
  - Paste
  - Paste File
  - To Uppercase
  - To Lowercase
  - Insert Unicode
  - Special Characters
  - Toggle Bold, Italics, Underline, Small Caps
  - Kerning
  - Delete
  - Inserting Text
  - Converting to a Mesh or Curve
  - Assigning Materials
- Properties
  - Shape
  - Texture Space
  - Geometry
  - Font
  - Paragraph
  - Text Boxes

Introduction

Text objects contain some text, and are in the same object type family as curves and surfaces ones, as fonts are vector data (they are made of curves).

Blender uses a “Font System” to manage mapping letter codes to geometry representing them in the 3D Viewport. This font system has its own *built-in* font, but it can use external fonts too, including *PostScript Type 1*, *OpenType* and *TrueType* fonts. And moreover, it can use any objects existing in the current blend-file as letters.

OpenSans Font

An example of an extruded text.

Text objects allow you to create and render 2D or 3D text, with various advanced layout options, like justifying and frames. By default, letters are just flat filled surfaces, exactly like any closed 2D curve. But, just like curves, you can extrude them, and apply modifiers to them (e.g. to make them follow a curve).

Text in Blender can be laid out in some relatively advanced ways, defining columns or blocks of text, using different alignments, and so on.

Those features are similar in concept to what you can find in DTP software (like Scribus), although at a very basic level currently.

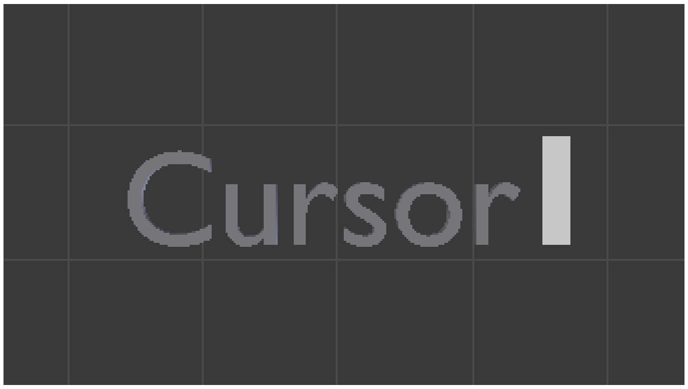
Tip

You can convert a text object, either to a curve, or directly to a mesh, using Convert in Object Mode.

Note

A maximum of 50,000 characters is allowed per text object. However, be forewarned that the more characters a single text object has, the slower the object will respond interactively.

Selecting



Text in Edit Mode.

In Edit Mode, your text has a white cursor, and as in any text editor, it determines where new chars will be inserted.

Select All `Ctrl-A`
: Selects the full text.

Top/Bottom `Shift-Ctrl-Home`/ `Shift-Ctrl-End`
: Moves the cursor to the start or end of the text object.

Next/Previous Character `Left`/ `Right`
: You can move the cursor with the arrow keys.

Next/Previous Word `Ctrl-Left`/ `Ctrl-Right`
: To move the cursor on a word's boundary.

Line Begin/End `Home`/ `End`
: Move the cursor to the beginning and end of a line respectively.

Next/Previous Line `Up`/ `Down`
: To jump between lines.

Next/Previous Block `PageUp`/ `PageDown`

To jump back/forward ten lines at a time.

Hold `Shift` while using the arrow keys to select a part of the text. You can use it to specify different materials, the normal/bold/italic style…

Editing

Editing text is quite different from other object types in Blender, and happens mainly in two areas. First, the 3D Viewport, where you type your text, and have a few shortcuts, e.g. for applying styles (see Font) – note however, that most Blender shortcuts you know in Edit Mode do not exist for texts. The second place is the Properties, especially the *Font* tab.

Editing text objects is similar to using a standard text editor but is not as full-featured and has some differences. The menu of the 3D Viewport header offers few options. You have no transform nor mirror tools, and so on. To leave Edit Mode use `Tab` as it does not insert a tab character in the text, but rather enters and exits Edit Mode, as with other object types.

Cut

Reference

Editor::	3D Viewport
Mode::	Edit Mode
Menu::	*Header ▸ Text ▸ Cut*
Shortcut::	`Ctrl-X`

To cut and copy text to the buffer, use the shortcut or the matching entry in the *Edit* menu.

Copy

Reference

Editor::	3D Viewport
Mode::	Edit Mode
Menu::	*Header ▸ Text ▸ Copy*

Shortcut:: `Ctrl-C`

To copy text to the buffer, use the shortcut or the matching entry in the *Edit* menu.

Paste

Reference

Editor:: 3D Viewport
Mode:: Edit Mode
Menu:: *Header* ▸ *Text* ▸ *Paste*
Shortcut:: `Ctrl-V`

To paste text from the buffer, use the shortcut or the matching entry in the *Edit* menu.

Paste File

Reference

Editor:: 3D Viewport
Mode:: Edit Mode
Menu:: *Header* ▸ *Text* ▸ *Paste File*

Inserts text from and external text file. This will bring up a File Browser for navigating to a valid UTF-8 file. As usual, be careful that the file does not have too many characters, as interactive response will slow down.

To Uppercase

Reference

Editor:: 3D Viewport

Mode:: Edit Mode
Menu:: *Header ▸ Text ▸ To Uppercase*

Changes the case of the selected text to uppercase.

To Lowercase

Reference

Editor:: 3D Viewport
Mode:: Edit Mode
Menu:: *Header ▸ Text ▸ To Lowercase*

Changes the case of the selected text to lowercase.

Insert Unicode

Reference

Editor:: 3D Viewport
Mode:: Edit Mode
Menu:: *Header ▸ Text ▸ Insert Unicode*

Opens a dialog box to input the entry of any Unicode character by entering its hexadecimal codepoint value.

See Wikipedia for a List of Unicode characters which list there respective hexadecimal codepoint values.

Special Characters

Reference

Editor:: 3D Viewport

Mode:: Edit Mode
Menu:: *Header ‣ Text ‣ Special Characters*

This is a limited character map to insert characters which aren't available from the keyboard. Many other special characters can be "composed", see Accent Characters. If you need others, you will have to copy-paste them from an external editor or character map program.

Note

The text buffer is in sync with the desktop clipboard. But if it is used within Blender the text formatting will be copied as well. For other ways of inserting a text, see Inserting Text.

Toggle Bold, Italics, Underline, Small Caps

Reference

Editor:: 3D Viewport
Mode:: Edit Mode
Menu:: *Header ‣ Text ‣ Toggle Bold/Italics/Underline/Small Caps*

To apply the *Bold*, *Italics*, *Underline* or *Small Caps* attribute to a set of characters, you either turn on the related setting prior to typing characters, or select existing text, and then toggle desired style from the menu.

Warning

Blender's *Bold* and *Italic* buttons do not work the same way as in other applications, as they also serve as placeholders for you to load up other fonts manually.

Kerning

Reference

Editor::	3D Viewport
Mode::	Edit Mode
Menu::	*Header ‣ Text ‣ Kerning*

Font kerning is the space between individual characters.

Decrease Kerning `Alt-Left`
Decreases the spacing between the characters on either side of the cursor.

Increase Kerning `Alt-Right`
Increase the spacing between the characters on either side of the cursor.

Reset Kerning
Sets the spacing between the characters on either side of the cursor to their initial value.

Delete

Reference

Editor::	3D Viewport
Mode::	Edit Mode
Menu::	*Header ‣ Text ‣ Delete*

Previous/Next Character
Deletes the character before or after the cursor.

Previous/Next Word
Deletes the word before or after the cursor.

Inserting Text

You can insert text in two ways: from the internal text buffer or from a text file.

Using an existing text data-block, you can convert it to an object from the Text editor's header, select *Edit* ‣ *Text to 3D Object*, *One Object* or *One Object per Line* depending on your needs.

It is also possible to paste from the clipboard or a file, while editing 3D text.

Accent Characters

Many special characters (such as accented chars, which are not directly available on your keyboard) can be "composed" using a combination of two other characters. To do so, type the main char, press `Alt-Backspace`, and then press the desired "modifier" to produce the special character. Some examples are given below:

- ã: `A`, `Alt-Backspace`, `~`
- á: `A`, `Alt-Backspace`, `'`
- à: `A`, `Alt-Backspace`, `\`
- â: `A`, `Alt-Backspace`, `^`
- å: `A`, `Alt-Backspace`, `O`
- æ: `A`, `Alt-Backspace`, `E`
- ª: `A`, `Alt-Backspace`, `-`
- ë: `E`, `Alt-Backspace`, `"`
- ç: `C`, `Alt-Backspace`, `,`
- ¢: `C`, `Alt-Backspace`, `|`
- ø: `O`, `Alt-Backspace`, `/`
- §: `S`, `Alt-Backspace`, `S`
- †: `|`, `Alt-Backspace`, `-`
- ‡: `|`, `Alt-Backspace`, `=`
- ©: `O`, `Alt-Backspace`, `C`
- ®: `O`, `Alt-Backspace`, `R`
- ™ : `T`, `Alt-Backspace`, `M`
- ½: `1`, `Alt-Backspace`, `2`
- ÷: `-`, `Alt-Backspace`, `:`
- ±: `-`, `Alt-Backspace`, `+`

Converting to a Mesh or Curve

In Object Mode, it is possible to convert a text object to a mesh or curve one, see Convert.

Tip

The topology of the result is usually a bit messy, so it may be useful to use a *Limited Dissolve* deletion, or apply a Remesh modifier at a low threshold, to clean up your mesh.

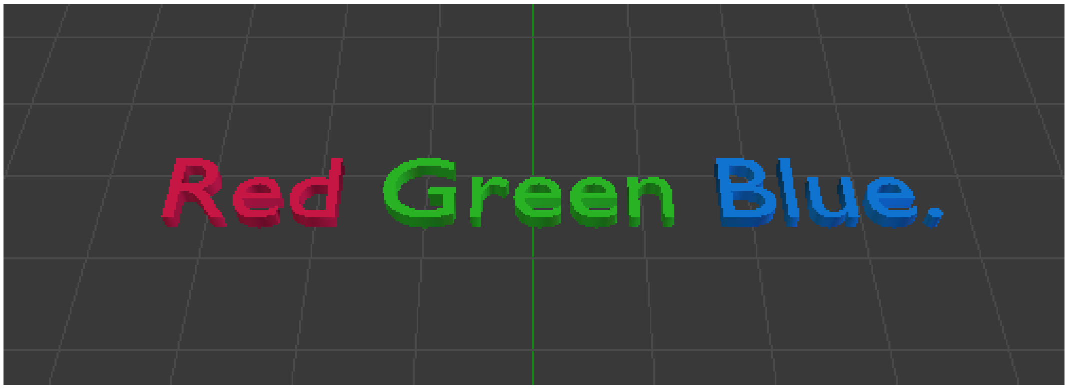
Assigning Materials

Reference

Mode::	Edit
Panel::	*Properties* ▸ *Materials*

Each character can have a different *Material index* in order to have different materials on different characters.

You can assign indices either as you type, or after by selecting blocks of text and clicking on the *Assign* button in the *Materials* panel.



Red Green Blue text example.

Properties

Shape

Reference

Mode:: All Modes
Panel:: *Properties ‣ Text ‣ Shape*

Most of the settings in the *Shape* panel are shared with those of Curves data-blocks, please refer to those for details.

Fast Editing
: Does not fill the letters in Edit Mode, only show their outline.

Texture Space

Each Object can have an automatically generated UV map, these maps can be adjusted here.

See Generated UV Properties for more information.

Geometry

Reference

Mode:: All Modes
Panel:: *Properties ‣ Font ‣ Geometry*

Offset
: Offset the control points of the curves defining the letters, which will make them thinner or thicker. Use with care, it can quickly lead to artifacts…

Extrusion, Taper & Bevel

The remaining settings of that panel, which are used to give volume to the letters, are also shared with the Curves data-blocks, please refer to those for details.

Note

How the Taper object effect works depends on how the curves defining the letters are built. The results can often look quite random…

Note

Bevel is applied to the curves defining the letters, which means that usually it will follow their outlines (there will be two parallel beveled curves, and not a single one, as one might expect).

Font

Reference

Mode::	All Modes
Panel::	*Properties* ‣ *Font* ‣ *Font*

Blender comes with a *built-in* font by default that is displayed in each of the four font style data-block menus. The *built-in* font is always present and shows in this list as “Bfont”. The data-block menu contains a list displaying the currently loaded fonts. Select one for each font style.

To load a different *Font*, click one of the *Load* buttons in the *Font* panel and navigate to a font file. The File Browser will give all valid fonts a capital “F” icon.

If you select a font that is unsupported by Blender, you will get the error `Not a valid font.`

Note

Location of Fonts on Unix

Fonts are typically located under `/usr/lib/fonts`, or some variant like `/usr/lib/X11/fonts`, but not always. They may be in other locations as well, such as `/usr/share/local` or `/usr/local/share`, and possibly related sub-trees.

Remember that the same font will be applied to all chars with same style in a text, but that a separate font is required for each style. For example, you will need to load an *Italics* font in order to make characters or words italic. Once the font is loaded you can apply that font "Style" to the selected characters or the whole object. In all, you would need to load a minimum of four different types of fonts to represent each style (Normal, Italics, Bold, Bold & Italics).

It is important to understand, that Blender does not care what font you load for "normal", "bold", etc., styles. This is how you can have up to four different fonts in use in the same text, but you have to choose between different styles of a same font, or different fonts. Blender has a number of typographic controls for changing the style and layout of text, found in the *Font* panel.

Bold

With no text selected, toggles new text to be **bold**. With text selected, toggles the selected text to be **bold**. Text can also be set to bold by selecting it then using the *Bold* entry in the *Text* menu of the 3D Viewport.

Italic

With no text selected, toggles new text to be *italic*. With text selected, toggles the selected text to be *italic*. Text can also be set to italic by selecting it then using the *Bold* entry in the *Text* menu of the 3D Viewport.

Underline

With no text selected, toggles new text to be underline. With text selected, toggles the selected text to be underline. Text can also be set to underline by selecting it then using the *Underline* entry in the *Text* menu of the 3D Viewport.

See also underline settings below.

Small Caps

With no text selected, toggles new text to be small capitals. With text selected, toggles the selected text to be small capitals. Text can also be set to small caps by selecting it then using the *Small Caps* entry in the *Text* menu of the 3D Viewport.

The size of the *Small Caps* can be changed with the Small Caps Scale setting.

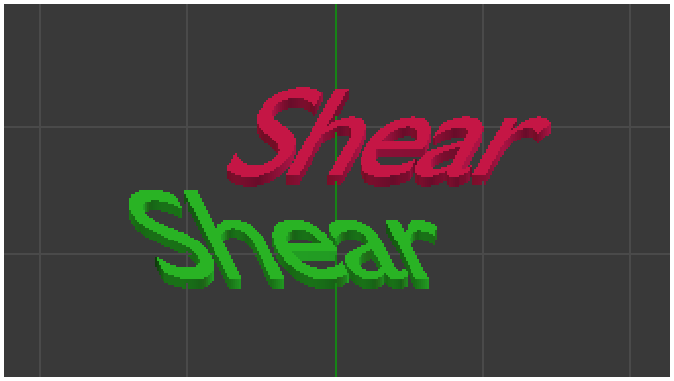
Transform

Size

Controls the size of the whole text (no way to control each char size independently). Note however, that chars with different fonts (different styles, see below) might have different visible sizes.

Shear

Controls the inclination of the whole text. As similar as it may seem, this is not the same thing as italics style.



Shear example.

Object Font

Allows individual objects to be used to render fonts, you can create/model your own complex font inside Blender! This field is used to select the objects prefix name (object "family") to be used to locate the individual characters used for typing. This is quite a complex process, so here are detailed steps to follow:

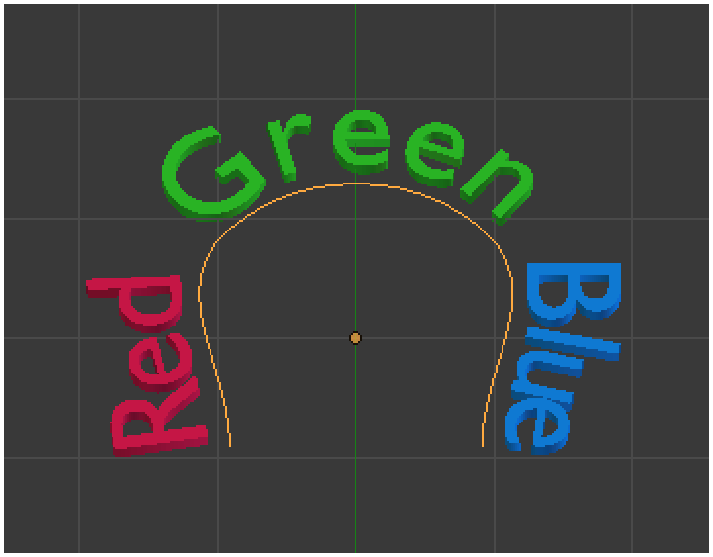
1. Create the font characters, each character can be any object type (mesh, curve, etc.). They must all have a name following the naming schema: "common prefix" followed by the "character name" (e.g. "ft.a", "ft.b", etc.).
2. For the text object, enable Instancing Vertices.
3. In the *Font* tab, fill the *Object Font* field with the "common prefix" of your "font" objects. Now, each time a character in your text matches the *suffix part* of a "font" object's name, this object is duplicated on this character.

Note

The objects are duplicated so that their center is positioned at the *lower right corner* of the corresponding characters.

Text on Curve

Select a curve object for the text object to follow.



Text on curve.

Tip

You should rather use the Curve modifier, which offers more control, and is the standard way to achieve such effects in modern Blender.

Underline Position
: This allows you to shift vertically the position of the underline.

Underline Thickness
: This controls the thickness of the underline.

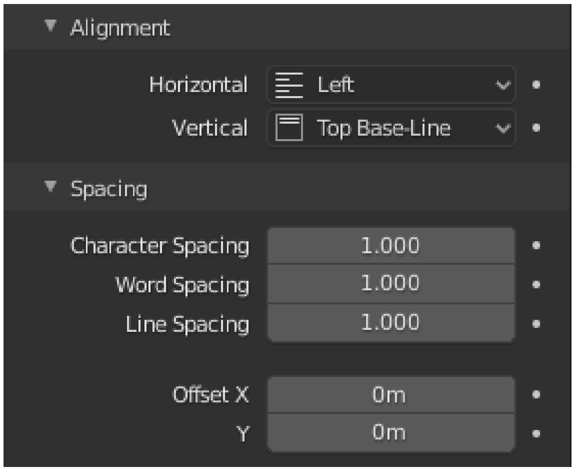
Small Caps Scale
: The scaling applied to capital letters to turn them into small caps.

Paragraph

Reference

Mode:: All
Panel:: *Properties ▸ Font ▸ Paragraph*

The *Paragraph* Panel has settings for the alignment and spacing of text.



▾ Alignment
Horizontal: Left
Vertical: Top Base-Line

▾ Spacing
Character Spacing: 1.000
Word Spacing: 1.000
Line Spacing: 1.000

Offset X: 0m
Y: 0m

The Paragraph panel.

Alignment

Horizontal

Left::	Aligns text to the left of the frames when using them, else uses the origin of the text object as the starting point of the text (which grows to the right).
Center::	Centers text in the frames when using them, else uses the origin of the text object as the mid-point of the text (which grows equally to the left and right).
Right::	Aligns text to the right of the frames when using them, else uses the origin of the text object as the ending point of the text (which grows to the left).
Justify::	Only flushes a line when it is terminated by a word wrap (**not** by a newline), and uses *whitespace* instead of *character spacing* (kerning) to fill lines.
Flush::	Always flushes the line, even when it is still being typed-in. It uses character spacing (kerning) to fill lines.

Note

Both *Justify* and *Flush* only work within frames.

Vertical

Top::	• With text boxes, aligns the top of the text to the to of the frames. • With no text box, aligns the top of the text to the origin of the object, and grows to the bottom.
Top Baseline::	• With text boxes, aligns the ‘top’ baseline of the te to the top of the frames. • With no text box, aligns the actual baseline of the text to the origin of the object, and grows to the bottom.

Note

That difference of reference point in the first line depending on usage of boxes or not is indeed

	confusing.
Middle::	- With text boxes, centers the text in the frames. - With no text box, centers the text on the origin of the object, and grows in both top and bottom directions equally.
Bottom Baseline::	- With text boxes, aligns the baseline of the text to the bottom of the frames. - With no text box, aligns the baseline of the text to the origin of the object, and grows to the top.
Bottom::	- With text boxes, align the bottom of the text to the bottom of the frames. - With no text box, align the bottom of the text to th origin of the object, and grows to the top.

Spacing

Character Spacing

A factor by which space between each character (kerning) is scaled in width.

In Edit Mode in the 3D Viewport, you can also control individual kerning at text cursor position by pressing `Alt-Left` / `Alt-Right` to decrease/increase it.

Word Spacing

A factor by which whitespace between words is scaled in width.

Line Spacing

A factor by which the vertical space between lines is scaled.

Offset X, Y

These settings control the X and Y offset of the text position within the object. This applies relatively to the object's origin, either to the whole text or, when using text boxes, to each frame.

Text Boxes

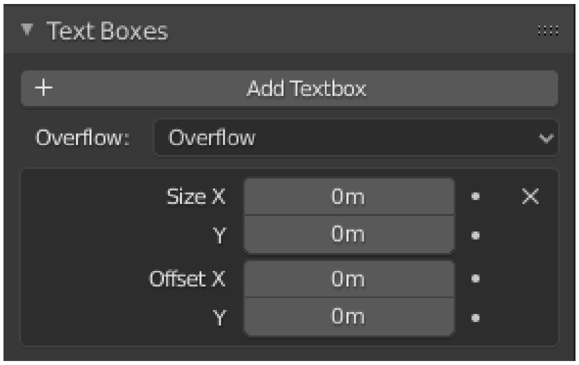
Reference

Mode:: All

Panel:: *Properties ‣ Font ‣ Text Boxes*

Text boxes (or frames) allow you to distribute the text among rectangular areas within a single text object. An arbitrary number of freely movable and re-sizable text frames are allowed per text object.

The text flows continuously from the lowest-numbered frame to the highest-numbered frame with text inside each frame word-wrapped. It flows between frames when a lower-numbered frame cannot fit any more text. If the last frame is reached, text overflows out of it (by default, see options below).



Overflow: Overflow

Size X 0m

Y 0m

Offset X 0m

Y 0m

Text Boxes panel.

Add Textbox
: Inserts a new frame, just after the current one (in text flow order). The new frame will have the same size and position as the selected one.

.._bpy.ops.font.textbox_remove:

(Remove Text Block)
: Delete the current frame.

Overflow
: How to handle text overflowing available space in the defined boxes.

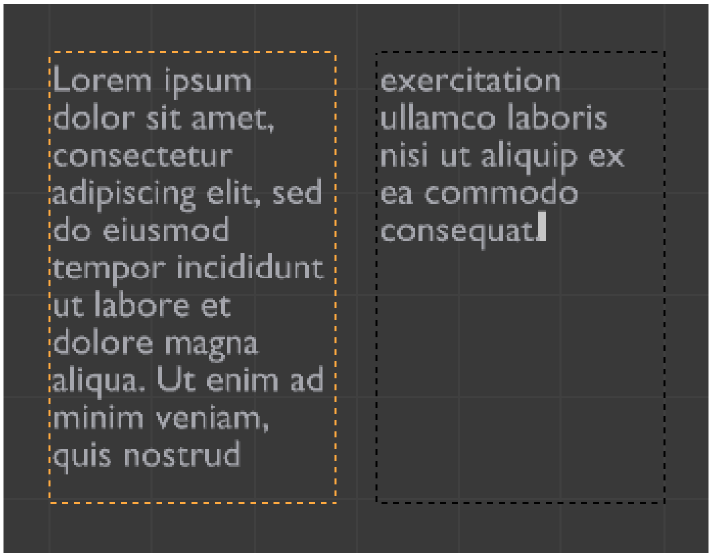
  Overflow:: Just keep text running out of the last box.

Scale to Fit::	Scale text to fit into the available space.
Truncate::	Hide the end of the text that does not fit into the available space.

Note
It will only truncate in *Object Mode*, in *Edit Mode* the whole text remains visible (and overflows as needed).

Size X, Y
Specifies the width and height of the text box, if set to **zero** no word wrapping happens (it is ignored, and the whole text box system is disabled if all are set to a null size).

Offset X, Y
Controls the *X* and *Y* offset of the frame, i.e. its position.



Lorem ipsum
dolor sit amet,
consectetur
adipiscing elit, sed
do eiusmod
tempor incididunt
ut labore et
dolore magna
aliqua. Ut enim ad
minim veniam,
quis nostrud

exercitation
ullamco laboris
nisi ut aliquip ex
ea commodo
consequat.

Multiple columns, text flowing between boxes.

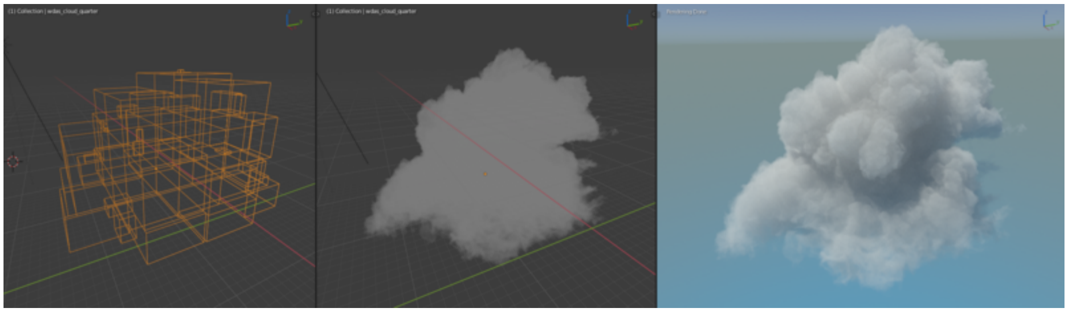
Volumes

- Introduction
    - Rendering
    - Limitations
- Properties
    - Grids
    - OpenVDB File
    - Viewport Display
    - Render

Introduction

Volume objects are containers used to represent OpenVDB files in Blender. OpenVDB is a library and file format for the interoperability and storage of volumetric data. OpenVDB files may be generated by other software such as Houdini, or from Blender's fluid simulation cache.

Volume objects can be created from the Add menu in the 3D Viewport, or by dragging and dropping vdb-files into Blender. For animations, a frame sequence of OpenVDB files can be imported.



WDAS cloud data set rendered in wireframe, Workbench, and Cycles.

Rendering

Rendering volumes works the same as rendering smoke simulations. By default, the Principled Volume shader is used for rendering volume objects. It will use grids named `density`, `color` and `temperature` by default. If these are not available, another grid name must be chosen in the shader nodes.

Limitations

- OpenVDB excels at representing sparse volumes, that aren't necessarily concentrated within a tight bounding box but may be spread out through space. However, in Blender, these are still rendered as dense volumes which is not ideal for performance and memory usage. This will be improved in future releases.

- OpenVDB files can also store level sets and points. While level set grids can be read, there is no current support for rendering them as surfaces. Importing OpenVDB points is not supported.

Properties

Grids

The List View shows the grids in the OpenVDB-file, listing their name and data type. A “grid” is a set of volumetric data, which typically stores the density of each voxel but can also contain temperatures, velocities and so on.

Click a grid to make the volume object display it.

OpenVDB File

File Path
    The VDB file to use.

Sequence
    Loads further VDB files, one for each frame in an animation. Much like with image sequences, all the files should have a numerical suffix in their name; so if you selected smoke-000.vdb in the *File Path*, there should be a smoke-001.vdb, a smoke-002.vdb and so on.

    Frames
        How many frames of the sequence to use.

    Start
        Scene frame at which the sequence should start.

    Offset
        How many frames of the sequence to skip at the beginning.

    Mode
        How the volume should behave before the sequence’s first frame (*Start*) and after its last (*Start* + *Frames*).

Clip::	Show nothing.
Extend::	Keep showing the first/last frame of the sequence.
Repeat::	Play the sequence again (and again, and again…).
Ping-Pong::	Play the sequence forwards, then backwards, then forwards again and so on.

Viewport Display

Wireframe

Method used to represent volumes in wireframe shading mode. For heavy volume data sets, it can be useful to set the object to always display as wireframe. This way, the 3D Viewport remains responsive but the volume still appears in the final render.

None::	The volume is not displayed in wireframe mode.
Bounds::	Displays the volume as a Bounding Box for the entire grid.
Boxes::	Displays bounding boxes for nodes in the volume tree.
Points::	Displays points for nodes in the volume tree.

Detail

The amount of detail to display for *Boxes* or *Points* wireframe mode.

Coarse::	Display one box or point for each intermediate tree node.
Fine::	Display a box or point for each leaf node containing 8×8 voxels.

Density

Thickness of the volume in the 3D Viewport. The density of the volume in the render is adjusted via Volume Shading.

Interpolation

Interpolation method to use for the visualization of the fluid grid.

Linear::	Linear interpolation between voxels. Gives good smoothness and speed.
Cubic::	Cubic interpolation between voxels. Gives smoothed high quality interpolation, but is slower.
Closest::	No interpolation between voxels. Gives raw voxels.

Slice

Renders only a single 2D section of the domain object.

Axis

Auto::	Adjust slice direction according to the view direction.
X/Y/Z::	Slice along the X, Y, or Z axis.

Position

Position of the slice relative to the length of the respective domain side.

Render

Space

Specifies how volume density and step size are computed.

Object::	Keeps volume *Density* and *Detail* the same regardless of object scale.
World::	Specify *Step Size* and *Density* in world space.

Step Size *Cycles Only*

Distance between volume samples. Lower values render more detail at the cost of performance. If set to zero, the step size is automatically determined based on voxel size.

Clipping *Cycles Only*

Value under which voxels are considered empty space to optimize rendering.

Precision *Cycles Only*

Specifies volume data precision. Lower values reduce memory consumption at the cost of detail.

Full::	Full float (Use 32 bit for all data).
Half::	Half float (Use 16 bit for all data).
Variable::	Automatically use less precision for less noticeable areas.

Velocity Grid *Cycles Only*

The name of the grid that contains voxel velocities, for calculating motion blur. This can be the name of a single grid containing 3D vectors, or a prefix of three separate grids containing scalar values. In the latter case, the X grid should have a name suffix of `x`, `.x` or `_x`, with similar conventions for the Y and Z grids.

Velocity Unit *Cycles Only*

Whether the velocity grid(s) specify distances per frame or per second.

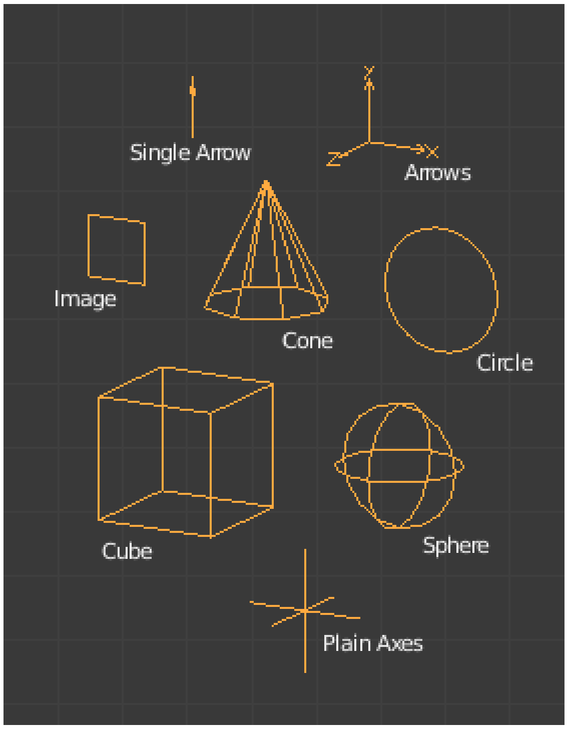
Velocity Scale *Cycles Only*

A custom multiplier to apply to the velocities in the VDB.

Empties

The “empty” is a single coordinate point with no additional geometry. Because an empty has no volume and surface, it cannot be rendered. Still it can be used as a handle for many purposes.

Primitives


Single Arrow
Y
Z
X
Arrows
Image
Cone
Circle
Cube
Sphere
Plain Axes

Empty Display Types.

Plain Axes

Displays as six lines, initially with one pointing in each of the +X, -X, +Y, -Y, +Z, and -Z axis directions.

Arrows

Displays as arrows, initially pointing in the positive X, Y, and Z axis directions, each with a label.

Single Arrow

Displays as a single arrow, initially pointing in the +Z axis direction.

Circle

Displays as a circle initially in the XZ plane.

Cube

Displays as a cube, initially aligned to the XYZ axes.

Sphere

Displays as an implied sphere defined by three circles. Initially, the circles are aligned, one each, to the X, Y, and Z axes.

Cone

Displays as a cone, initially pointing in the +Y axis direction.

Image

Empties can display images. This can be used to create reference images, including blueprints or character sheets to model from. The image is displayed regardless of the 3D display mode.

Empty Displays settings can be accessed from *Properties* ▸ *Object Data* ▸ *Empty* panel.

Offset X, Y
: Offset the image origin (where 1.0 represents the width/height of the image).

X=0.5, Y=0.5::	Object origin at image center.
X=0.0, Y=0.0::	Object origin at image bottom, left.
X=1.0, Y=1.0::	Object origin at image top, right.

Depth

Default::	Use normal depth behavior.
Front::	Always display on top of other objects.
Back::	Always display behind of other objects.

Tip

When using the image as a reference for modeling, it can be useful to set the depth to *Front*, with a low *Opacity*.

Side

Both::	Display both the front and back of the empty.
Front::	Only display the front of the image.
Back::	Only display the back of the image.

Tip

This is useful if you are using an image as a reference where you have photos from both the front and back, so two empty images can be set only to show when viewed from the correct side.

Show in

Orthographic

Show in orthographic view.

Perspective

Show in perspective view.

Hint

It's often useful to disable this so reference images don't *get in the way* when viewing a model.

Only Axis Aligned

Only displays the image contents when the view is aligned with the object's local axis.

Opacity

Blends the image with the background. The value slider adjusts the opacity of the image, changing how much of the image is blended with the background.

Editing

An empty can only be edited in Object Mode, which includes its transformation and parenting properties. For other tools see the Object section.

Apply Scale `Ctrl-A`

While empties don't exactly have any object data attached to them which can be used for supporting "true" apply scale (i.e. with non-uniform scaling), they do have *Display Size* which controls how large the empties are displayed (before scaling). This works by taking the scale factor on the most-scaled axis, and combines this with the existing empty *Display Size* to maintain the correct dimensions on that axis.

Properties

Display As

The Primitives empty type to display in the 3D Viewport.

Size

Controls the size of the empties visualization. This does not change its scale, but functions as an offset.

Usage

Empties can serve as transform handles. Some examples of ways to use them include:

Parent object for a group of objects

An empty can be parented to any number of other objects. This gives the user the ability to control a group of objects easily, and without affecting a render.

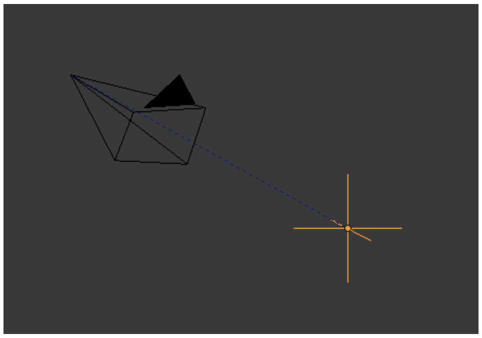
Target for constraints

An empty can also be used as a target for normal, or bone constraints. This gives the user far more control; for instance, a rig can easily be set up to enable a camera to point towards an empty using the *Track to* constraint.

Array offset

An empty can be used to offset an Array Modifier, meaning complex deformations can be achieved by only moving a single object.

An example of an empty being used to control an array.



An example of an empty being used to control the Track To constraint.

Other common uses:

- Placeholders
- Rigging controls
- DOF distances

- Reference Images

Modifiers

- Introduction
    - Categories
    - Interface
    - Example
- Common Modifier Options
    - Vertex Group
    - Texture

Built-In Modifiers

- Edit
    - Data Transfer Modifier
    - Mesh Cache Modifier
    - Mesh Sequence Cache Modifier
    - UV Project Modifier
    - UV Warp Modifier
    - Vertex Weight Edit Modifier
    - Vertex Weight Mix Modifier
    - Vertex Weight Proximity Modifier
- Generate
    - Array Modifier
    - Bevel Modifier
    - Boolean Modifier
    - Build Modifier
    - Decimate Modifier
    - Edge Split Modifier
    - Geometry Nodes Modifier
    - Mask Modifier
    - Mesh to Volume Modifier
    - Mirror Modifier
    - Multiresolution Modifier
    - Remesh Modifier

  - Screw Modifier
  - Skin Modifier
  - Solidify Modifier
  - Subdivision Surface Modifier
  - Triangulate Modifier
  - Volume to Mesh Modifier
  - Weld Modifier
  - Wireframe Modifier
- Deform
  - Armature Modifier
  - Cast Modifier
  - Curve Modifier
  - Displace Modifier
  - Hook Modifier
  - Laplacian Deform Modifier
  - Lattice Modifier
  - Mesh Deform Modifier
  - Shrinkwrap Modifier
  - Simple Deform Modifier
  - Smooth Modifier
  - Smooth Corrective Modifier
  - Smooth Laplacian Modifier
  - Surface Deform Modifier
  - Volume Displace Modifier
  - Warp Modifier
  - Wave Modifier
- Normals
  - Normal Edit Modifier
  - Weighted Normal Modifier
  - Smooth By Angle Modifier
- Physics
  - Cloth Modifier
  - Collision Modifier
  - Dynamic Paint Modifier
  - Explode Modifier
  - Fluid Modifier
  - Ocean Modifier

    - Particle Instance Modifier
    - Particle System Modifier
    - Soft Body Modifier

Introduction

Modifiers are automatic operations that affect an object's geometry in a non-destructive way. With modifiers, you can perform many effects automatically that would otherwise be too tedious to do manually (such as subdivision surfaces) and without affecting the base geometry of your object.

They work by changing how an object is displayed and rendered, but not the geometry which you can edit directly. You can add several modifiers to a single object to form The Modifier Stack and *Apply* a modifier if you wish to make its changes permanent.

They can be added to the active object using the Add Modifier operator, the "Add Modifier" button at the top of Modifiers tab in the Properties, or using `Shift-A` in the same tab. New modifiers are always added at the bottom of the stack (i.e. will be applied last).

There are many built-in modifiers but Blender also allows users to make their own modifiers through Geometry Nodes.

Categories

There are four categories of built-in modifiers:

Edit

Similar to the *Deform* modifiers (see below), however, they usually do not directly affect the geometry of the object, but some other data, such as vertex groups.

Generate

Constructive/destructive modifiers that will affect the whole Topology of the mesh. They can change the general appearance of the object, or add new geometry to it…

Deform

Unlike *Generate* ones above, these modifiers only change the shape of an object, without altering its topology.

Simulate

Represent physics simulations. In most cases, they are automatically added to the modifiers stack whenever a *Particle System* or *Physics* simulation is enabled. Their only role is to define the position in the modifier stack from which is taken the base data for the simulation they represent. As such, they typically have no properties, and are controlled by settings exposed in separate sections of the Properties.

You will also notice a category called “Hair”, this category comes from a bundled Asset Library that is distributed with Blender. See Hair Nodes for more information.

Users can make their own categories by making geometry node groups assets and assigning them to a Asset Catalog. This catalog name will be the category name. If a user creates a catalog with the same name as one of the built-in categories the node group will be added to the bottom of the corresponding menu.

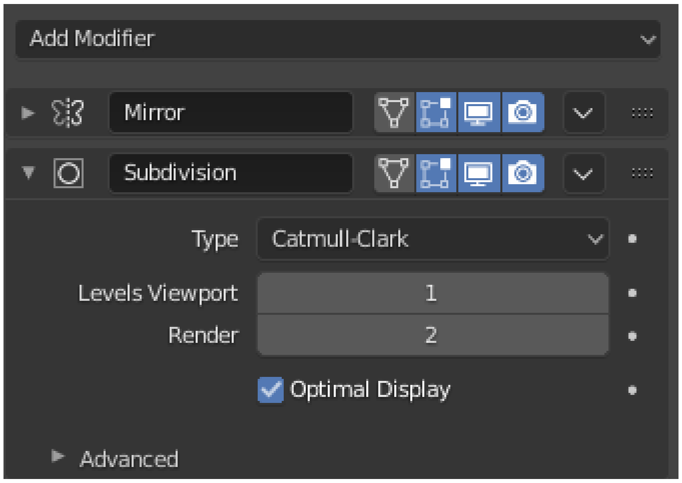
Node Groups that are non-assets or that do not belong to a category will be available in the “Unassigned” sub-menu.

Note

Geometry Node Groups must have the Modifier property enabled for the node group to show up in the Add Modifier menu.

Interface

Each modifier’s interface shares the same basic components, see Fig. Panel layout (Subdivision Surface as an example)..



Type: Catmull-Clark

Levels Viewport: 1

Render: 2

☑ Optimal Display

Panel layout (Subdivision Surface as an example).

At the top is the panel header. The icons each represent different settings for the modifier (left to right):

Expand (down/right arrow icon)
: Collapse modifier to show only the header and not its options.

Type
: An icon as a quick visual reference of the modifier's type.

Name
: Every modifier has a unique name per object. Two modifiers on one object must have unique names, but two modifiers on different objects can have the same name. The default name is based on the modifier type.

Show on Cage (vertices triangle icon) – Meshes only
: Depends on the previous setting, if enabled, the modified geometry can also be edited directly, instead of the original one.

> **Warning**
>
> While it shows edited items in their final, modified positions, you are still actually editing original data. This can lead to strong and unpredictable effects with some tools, and should be disabled

whenever you need to perform complex or precise editing on the mesh.

Show in Edit Mode (vertices square icon)

Display the modified geometry in Edit Mode, as well as the original geometry which you can edit.

Show in Viewport (screen icon)

Toggle visibility of the modifier's effect in the 3D Viewport.

Render (camera icon)

Toggle visibility of the modifier's effect in the render.

Note

The *Square*, *Triangle* and *Surface* icons may not be available, depending on the type of object and modifier.

Apply On Spline Points (point surface icon) – Curves, surfaces and texts only

Apply the whole modifier stack up to and including that one on the curve or surface control points, instead of their tessellated geometry.

Note

By default, curves, texts and surfaces are always converted to mesh-like geometry before that the modifier stack is evaluated on them.

Extras

Apply `Ctrl-A`

Makes the modifier "real": converts the object's geometry to match the applied modifier's results, and deletes the modifier.

When applying a modifier to an object that shares Object Data between multiple objects, the object must first be made a Single

User which can be performed by confirming the pop-up message.

Warning

Applying a modifier that is not first in the stack will ignore the stack order (it will be applied as if it was the first one), and may produce undesired results.

Apply as Shape Key

Stores the result of that modifier in a new relative shape key and then deletes the modifier from the modifier stack. This is only available with modifiers that do not affect the topology (typically, *Deform* modifiers only).

Note

Even though it should work with any geometry type that supports shape keys, currently it will only work with meshes.

Save as Shape Key

Stores the result of that modifier in a new relative shape key and keeps the modifier in the modifier stack. This is only available with modifiers that do not affect the topology (typically, *Deform* modifiers only).

Duplicate `Shift-D`

Creates a duplicate of the modifier just below current one in the stack.

Copy to Selected

Copies the modifier from the Active object to all selected objects.

Move to First/Last

Moves the modifier to the first or last position in the modifier stack.

Pin to Last

Keeps the modifier at the end of the modifier stack. When a modifier is pinned, a pin icon will be displayed on the right side of the panel's header.

Move to Nodes

Converts the existing Geometry Nodes Modifier node tree to a group node to be reused in other node trees. See Move to Nodes Operator for more information.

This operator is only available for the Geometry Nodes Modifier.

Delete `X`, `Delete`

Delete the modifier.

Move `::::`

Move the modifier up/down in the stack, changing the evaluation order of the modifiers.

A modifier is not movable if Pin to Last is enabled.

Below this header, all of the options unique to each modifier will be displayed.

Tip

Use `Alt` to affect all selected objects at once when performing operators such as add, apply, remove, and move to index.

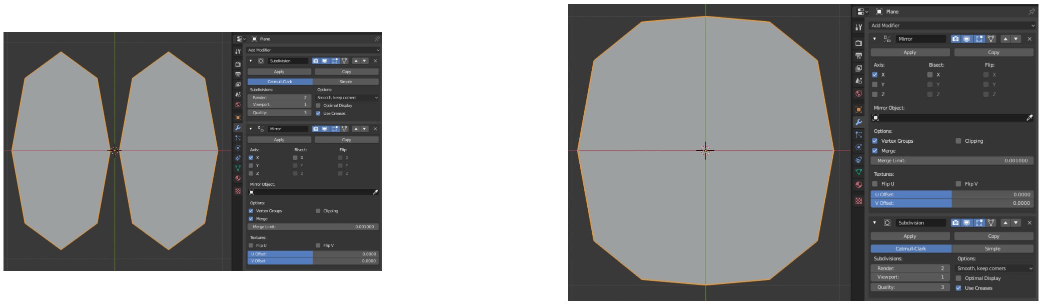
See Multi-Object Editing for more information.

The Modifier Stack

Modifiers are a series of non-destructive operations which can be applied on top of an object's geometry. You can be apply them in almost any order. This kind of functionality is often referred to as a "modifier stack" and is also found in several other 3D applications.

In a modifier stack, the order in which modifiers are applied has an effect on the result. Therefore the modifiers can be re-arranged by clicking the grab widget (`::::`) in the top right, and moving the selected modifier up or down. For example, the image below shows Subdivision Surface and Mirror modifiers that have switched places.

Modifier Stack example.



The Mirror modifier is the last item in the stack and the result looks like two surfaces.

The Subdivision Surface modifier is the last item in the stack and the result is a single merged surface.

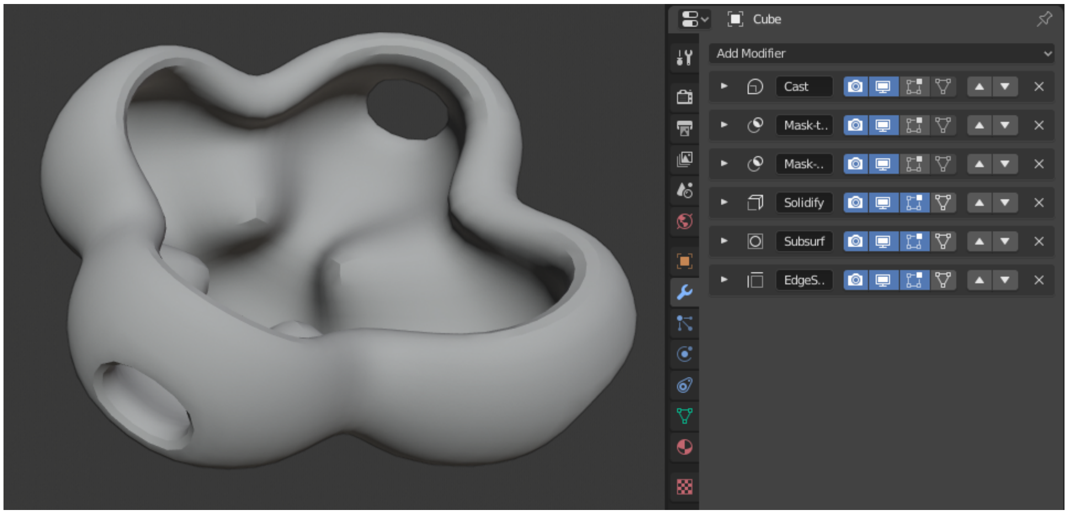
Modifiers are calculated from top to bottom in the stack. In this example, the desired result (on right) is achieved by first mirroring the object, and then calculating the subdivision surface.

Active Modifier

A modifier in the stack can be selected to mark in as Active, the active modifier displays an outline around the modifier's panel. To set an active modifier, select an area of the modifier's panel background, the modifier's icon, or, select a modifier in the Outliner.

The active modifier is used by the Geometry Node Editor to determine which node group is being modified.

Example


Cube
Add Modifier
Cast
Mask-t..
Mask-..
Solidify
Subsurf
EdgeS..

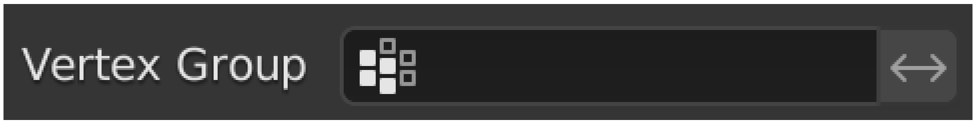
In this example a simple subdivided cube has been transformed into a rather complex object using a stack of modifiers.

Download example file.

Common Modifier Options

Some options are commonly used by many modifiers, and share the same behavior across all of those. In particular, many offer ways to precisely mask and weight their effect on a vertex basis (using either vertex groups and/or textures).

Vertex Group



Typical modifier Vertex Group options.

Vertex Groups are an easy way to control which vertices are affected by a modifier, and to which extent (using their weights). They are available when modifying meshes or lattices.

Tip

Vertex groups can also be edited and even animated using the Vertex Weight modifiers.

Vertex Group

The vertex group name.

Warning

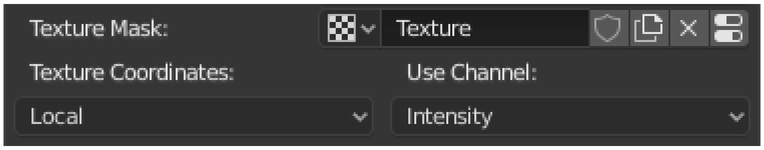
The group is referenced by its name. That means that if you rename it, the link to the renamed vertex group will be lost by all modifiers using it (their field will turn red), and you’ll have to select the proper group again in all of them.

Invert <–>

Inverts the influence of the selected vertex group, meaning that the group now represents vertices that will not be deformed by the modifier.

The setting reverses the weight values of the group. Only available in some modifiers.

Texture



Texture Mask: Texture

Texture Coordinates: Local

Use Channel: Intensity

Typical modifier Texture options.

Those options allow to use any kind of image (including parametric ones) to control the modifier’s effect. Most of the time, only the value (grayscale) of the texture is used, but in some cases (like with some modes of the [Displace modifier](#)), the whole RGB color components might be exploited.

Tip

Textures can be animated (either using videos, or by animating the mapping coordinates…).

Texture

The [texture data-block](#) to use.

Tip

By clicking on the right-most button of this field (with the settings icon), you can go directly to the selected texture's settings in the *Texture Properties* tab.

Texture Coordinates

The texture's coordinates to get each vertex' value:

UV

Take texture coordinates from face UV coordinates.

UV Map

The UV Map from which to take texture coordinates. If the object has no UV coordinates, it falls back to the *Local* coordinate system. If this field is blank, but there is a UV map available (e.g. just after adding the first UV map to the mesh), the currently active UV map will be used.

Note

Since UV coordinates are specified per face, the UV texture coordinate system currently determines the UV coordinate for each vertex from the first face encountered which uses that vertex. Any other faces using that vertex are ignored.

This may lead to artifacts if the mesh has non-contiguous UV coordinates.

Object

Take the texture coordinates from another object's coordinate system.

Object

The object from which to take texture coordinates. Moving the object will therefore alter the coordinates of the texture mapping.

If this field is blank, it falls back to the *Local* coordinate system.

Note

Moving the original object will **also** result in a texture coordinate update. As such, if you need to maintain a displacement coordinate system while moving the modified object, consider parenting the coordinate object to the modified object.

Global

Take the texture coordinates from the global coordinate system.

Local

Take the texture coordinates from the object's local coordinate system.

Use Channel

Which channel to use as value source (only available with a few modifiers currently, others follow the *Intensity* behavior, unless otherwise specified).

Intensity

The average of the RGB channels (if RGB(1.0, 0.0, 0.0) value is 0.33).

Red/Green/Blue/Alpha

One of the color channels' values.

Hue

The hue from the HSV color model (i.e; the color in the standard wheel, e.g. blue has a higher hue value than yellow).

Saturation

The saturation from the HSV color model (e.g. the value for pure red is 1.0, for gray is 0.0).

Value

The value from the HSV color model.

Note

All of the channels above are gamma corrected, except for *Intensity*.

Edit

- Data Transfer Modifier
- Mesh Cache Modifier
- Mesh Sequence Cache Modifier
- UV Project Modifier
- UV Warp Modifier
- Vertex Weight Edit Modifier
- Vertex Weight Mix Modifier
- Vertex Weight Proximity Modifier

Data Transfer Modifier

The Data Transfer modifier transfers several types of data from one mesh to another. Data types include vertex groups, UV maps, Color Attributes, custom normals…

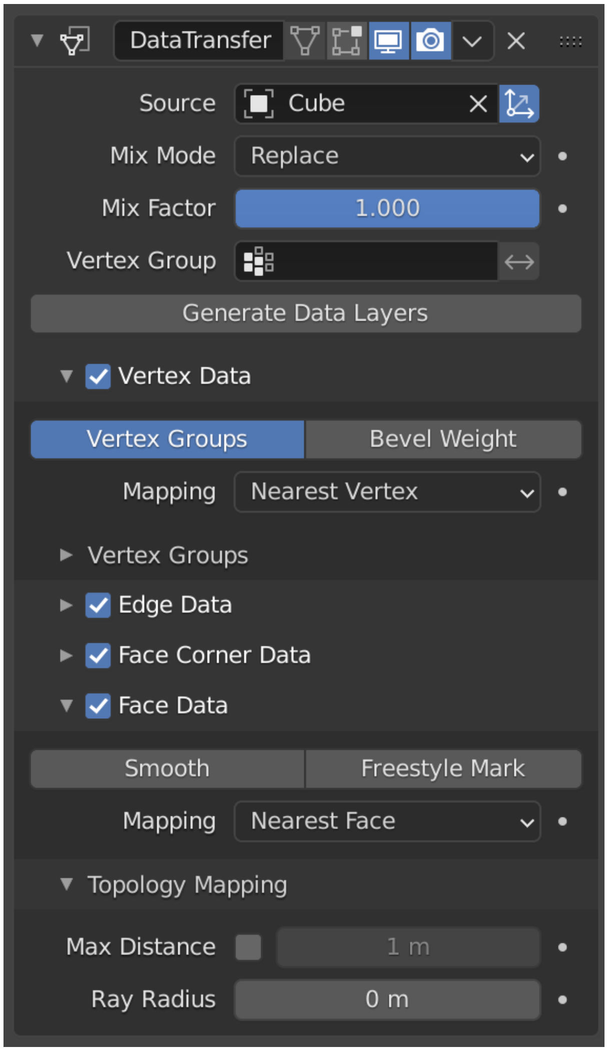
Transfer works by generating a mapping between source mesh's elements (vertices, edges, etc.) and destination ones, either on a one-to-one basis, or mapping several source elements to a single destination one, using interpolation.

Transferring normals between objects, see example blend-file.

See also

Transfer Mesh Data Operator

Options


Source: Cube

Mix Mode: Replace

Mix Factor: 1.000

Vertex Data ☑

Mapping: Nearest Vertex

Edge Data ☑

Face Corner Data ☑

Face Data ☑

Mapping: Nearest Face

Max Distance ☐ 1 m

Ray Radius: 0 m

DataTransfer
Vertex Group
Generate Data Layers
Vertex Groups
Bevel Weight
Vertex Groups
Smooth
Freestyle Mark
Topology Mapping

Data Transfer Modifier.

Source

Mesh object to copy data from.

If the button to the right of the field is unset, both the source and the destination geometry is considered in global space when generating the mapping, otherwise they are evaluated in local space (i.e. as if both object's origins were at the same place).

Mix Mode

Controls how destination data are affected:

All

Replaces everything in destination (note that *Mix Factor* is still used).

Above Threshold

Only replaces destination value if it's above given threshold *Mix Factor*. How that threshold is interpreted depends on the data type, note that for Boolean values this option fakes a logical AND.

Below Threshold

Only replaces destination value if it's below given threshold *Mix Factor*. How that threshold is interpreted depends on the data type, note that for Boolean values this option fakes a logical OR.

Mix, Add, Subtract, Multiply

Apply that operation, using mix factor to control how much of source or destination value to use. Only available for a few types (vertex groups, Color Attributes).

Mix Factor
: How much of the transferred data gets mixed into existing one (not supported by all data types).

Vertex Group
: Allows per-element fine control of the mix factor. Vertex group influence can be reverted using the small “arrow” button to the right.

Generate Data Layers
: This modifier cannot generate needed data layers itself. Once the set of source data to transfer is selected, this button shall be used to generate matching destination layers, if needed.

Selection of Data to Transfer

To keep the size of the modifier reasonable, the kind of elements to be affected must be selected first (vertices, edges, face corners and/or faces).

Mapping Type
: How is generated the mapping between those source and destination elements. Each type has its own options, see Geometry Mapping below for details.

Data Types
: The left column of toggle buttons, to select which data types to transfer.

Multi-layers Data Types Options
: In those cases (vertex groups, Color Attributes, UVs), one can select which source layers to transfer (usually, either all of them, or a single specified one), and how to affect destination (either by matching names, matching order/position, or, if a single source is selected, by specifying manually the destination layer).

Islands Handling Refinement
: This setting only affects UV transfer currently. It allows to avoid a given destination face to get UV coordinates from different source UV islands.

Keeping it at 0.0 means no island handling at all. Typically, small values like 0.02 are enough to get good results, but if you are mapping from a very high-poly source towards a very low-poly destination, you may have to raise it quite significantly.

Usage

First key thing to keep in mind when using this modifier is that it will **not** create destination data layers. *Generate Data Layers* button shall always be used for this purpose, once the set of source data to transfer has been selected. It should also be well understood that creating those data layers on destination mesh is **not** part of the modifier stack, which means e.g. that they will remain even once the modifier is deleted, or if the source data selection is modified.

Geometry Mapping

Geometry mapping is how a given destination mesh relates to a source mesh. In this process a destination vertex/edge/… gets a part of the source mesh assigned with functions as its data source. It is crucial to understand this topic well to get good results with this modifier.

Topology

The simplest option, expects both meshes to have identical number of elements, and match them by order (indices). Useful e.g. between meshes that were identical copies, and got deformed differently.

One-To-One Mappings

Those always select only one source element for each destination one, often based on shortest distance.

Vertices

Nearest Vertex

Uses source's nearest vertex.

Nearest Edge Vertex

Uses source's nearest vertex of source's nearest edge.

Nearest Face Vertex
Uses source's nearest vertex of source's nearest face.

Edges

Nearest Vertices
Uses source's edge which vertices are nearest from destination edge's vertices.

Nearest Edge
Uses source's nearest edge (using edge's midpoints).

Nearest Face Edge
Uses source's nearest edge of source's nearest face (using edge's midpoints).

Face Corners

A face corner is not a real element by itself, it's some kind of split vertex attached to a specific face. Hence both vertex (location) and face (normal, …) aspects are used to match them together.

Nearest Corner and Best Matching Normal
Uses source's corner having the most similar *split* normal with destination one, from those sharing the nearest source's vertex.

Nearest Corner and Best Matching Face Normal
Uses source's corner having the most similar *face* normal with destination one, from those sharing the nearest source's vertex.

Nearest Corner of Nearest Face
Uses source's nearest corner of source's nearest face.

Faces

Nearest Face
Uses source's nearest face.

Best Normal-Matching
Uses source's face which normal is most similar with destination one.

Interpolated Mappings

Those use several source elements for each destination one, interpolating their data during the transfer.

Vertices

Nearest Edge Interpolated

Uses nearest point on nearest source's edge, interpolates data from both source edge's vertices.

Nearest Face Interpolated

Uses nearest point on nearest source's face, interpolates data from all that source face's vertices.

Projected Face Interpolated

Uses point of face on source hit by projection of destination vertex along its own normal, interpolates data from all that source face's vertices.

Edges

Projected Edge Interpolated

This is a sampling process. Several rays are cast from along the destination's edge (interpolating both edge's vertex normals), and if enough of them hit a source's edge, all hit source edges' data are interpolated into destination one.

Face Corners

A face corner is not a real element by itself, it's some kind of split vertex attached to a specific face. Hence both vertex (location) and face (normal, …) aspects are used to match them together.

Nearest Face Interpolated

Uses nearest point of nearest source's face, interpolates data from all that source face's corners.

Projected Face Interpolated

Uses point of face on source hit by projection of destination corner along its own normal, interpolates data from all that source face's corners.

Faces

Projected Face Interpolated

This is a sampling process. Several rays are cast from the whole destination's face (along its own normal), and if enough of them hit a source's face, all hit source faces' data are interpolated into destination one.

Topology Mapping

Max Distance

When the "pressure stylus" icon button to the right is enabled, this is the maximum distance between source and destination to get a successful mapping. If a destination element cannot find a source one within that range, then it will get no transferred data.

This allows to transfer a small sub-detailed mesh onto a more complete one (e.g. from a "hand" mesh towards a "full body" one).

Ray Radius

The starting ray radius to use when Ray Casting against vertices or edges. When transferring data between meshes Blender performs a series of ray casts to generate mappings. Blender starts with a ray with the radius defined here, if that does not return a hit then the radius is progressively increased until a positive hit or a limit is reached.

This property acts as an accuracy/performance control; using a lower ray radius will be more accurate however, might take longer if Blender has to progressively increase the limit. Lower values will work better for dense meshes with lots of detail while larger values are probably better suited for simple meshes.

Mesh Cache Modifier

The Mesh Cache modifier main use is for animated mesh data to be applied to a mesh and played back, deforming the mesh.

This works in a similar way to shape keys, but is aimed at playing back external files and is often used for interchange between applications.

Tip

Both MDD and PC2 depend on the vertex order on the mesh remaining unchanged. This is a limitation of this method, so take care not to add, remove or reorder vertices once this modifier is used.

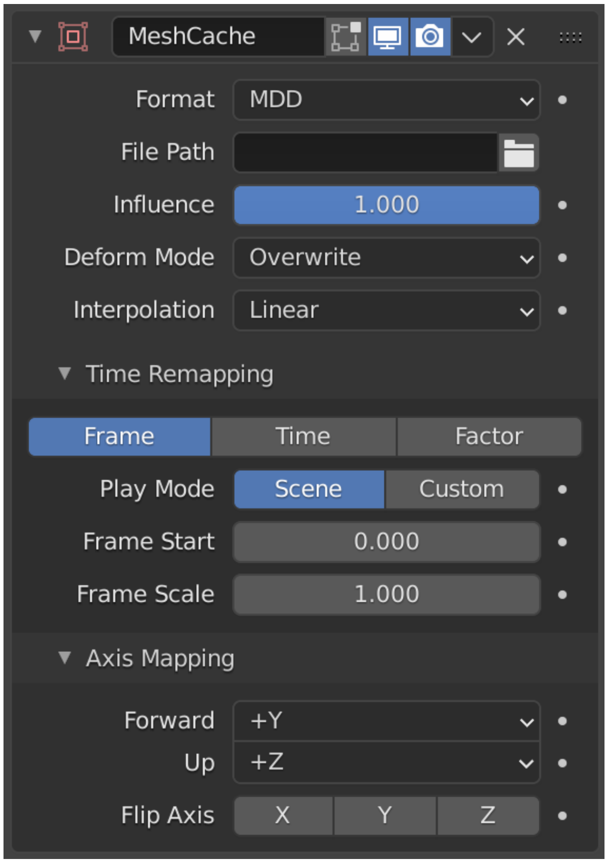
Options

Format
: The input file format (currently `.mdd` and `.pc2` are supported).

File Path
: Path to the cache file.

Influence
: Factor to adjust the influence of the modifier's deformation, useful for blending in/out from the cache data.

Deform Mode
: This setting defaults to *Overwrite* which will replace the vertex locations with those in the cache file. However, you may want to use shape keys, for example, and mix them with the mesh cache. In this case you can select the *Deform* option which integrates deformations with the mesh cache result.



Format MDD
File Path
Influence 1.000
Deform Mode Overwrite
Interpolation Linear
Play Mode Scene
Frame Start 0.000
Frame Scale 1.000
Forward +Y
Up +Z

Mesh Cache Modifier.

Note

This feature is limited to making smaller, isolated edits and will not work for larger changes such as re-posing limbs.

Interpolation

None, or *Linear*, which will blend between frames. Use linear when the frames in the cache file do not match up exactly with the frames in the blend-file.

Vertex Group

If set, restrict the effect to the only vertices in that vertex group.

Invert <–>

Inverts the influence of the selected vertex group, meaning that the group now represents vertices that will not be deformed by the modifier.

The setting reverses the weight values of the group.

Time Remapping

Time Mode

Select how time is calculated.

Frame::	Allows you to control the frames, which will ignore timing data in the file but is often useful since it gives simple control.
Time::	

Evaluates time in seconds, taking into account timing information from the file (offset and frame-times).

Factor:: Evaluates the entire animation as a value in the [0, 1] range.

Play Mode

Select how playback operates.

Scene:: Use the current frame from the scene to control playback.

Frame Start

Play the cache starting from this frame.

Frame Scale

Scale time by this factor (applied after the start value).

Custom:: Control animation timing manually.

Evaluation Value

Property used for animation time, this gives more control of timing (typically this value will be animated).

Axis Mapping

Forward/Up Axis

The axis for forward and up used in the source file.

Flip Axis

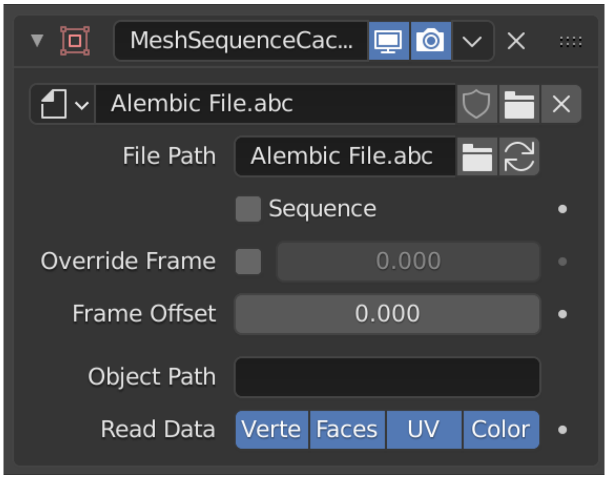
In rare cases you may also need to flip the coordinates on an axis.

Mesh Sequence Cache Modifier

The Mesh Sequence Cache modifier loads data from Alembic and USD files. It supports static meshes, but is mostly used to load animated meshes. Despite its name, this modifier also supports curves. It also handles file sequences, as well as meshes and curves with varying topology (like the result of fluid simulations).

When importing an Alembic or USD file, Mesh Sequence Cache modifiers are automatically added to time-varying meshes. For time-varying object transforms (so animation of rotation, location, or scale), the Transform Cache Constraint is used. Files other than Alembic or USD, like MDD and PC2 files, can be loaded using the Mesh Cache modifier.

Options



MeshSequenceCac...

Alembic File.abc

File Path: Alembic File.abc

☐ Sequence

Override Frame ☐ 0.000

Frame Offset 0.000

Object Path

Read Data: Verte, Faces, UV, Color

Cache File

    Data-block menu to select the Alembic or USD file.

File Path

    Path to Alembic or USD file.

Object Path

    The path to the Alembic or USD object inside the archive or stage.

Read Data

    Type of data to read for a mesh object, respectively: vertices, polygons, UV maps, and Color Attributes.

    Vertices, Faces, UV, Color

Time

Sequence

Whether or not the cache is separated in a series of files.

Override Frame

Whether to use a custom frame for looking up data in the cache file, instead of using the current scene frame.

The *Frame* value is the time to use for looking up the data in the cache file, or to determine which to use in a file sequence.

Frame Offset

Subtracted from the current frame to use for looking up the data in the cache file, or to determine which file to use in a file sequence.

Velocity

Velocity Attribute

The name of the Alembic attribute used for generating motion blur data; by default, this is `.velocities` which is standard for most Alembic files.

Note

The *Velocity Attribute* option is currently for Alembic files only.

Velocity Unit

Defines how the velocity vectors are interpreted with regard to time.

Frame::	The velocity unit was encoded in frames and does not need to be scale by scene FPS.
Second::	The velocity unit was encoded in seconds and needs to be scaled by the scene FPS (1 / FPS).

Note

The *Velocity Unit* option is currently for Alembic files only.

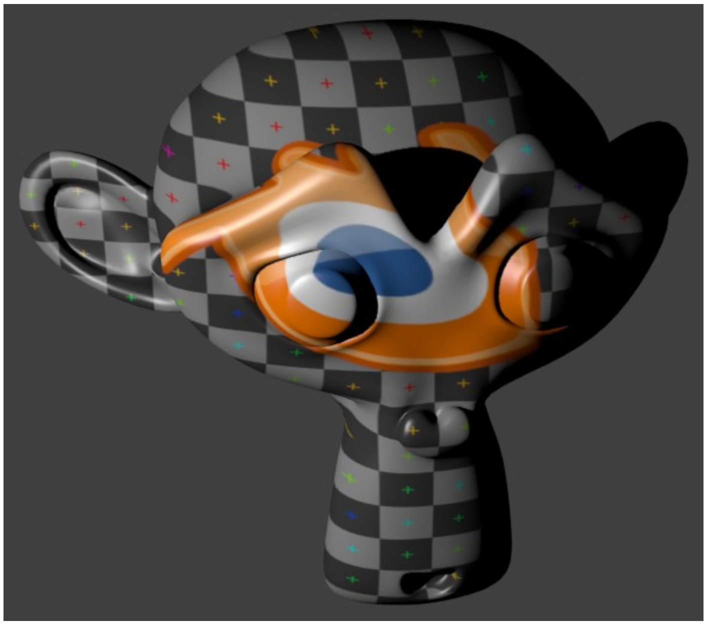
Velocity Scale

Multiplier used to control the magnitude of the velocity vector for time effects such as motion blur.

Note

The *Velocity Scale* option is currently for Alembic files only.

UV Project Modifier



Projecting the Blender logo onto Suzanne.

The *UV Project* modifier acts like a slide projector. It emits a UV map from the negative Z axis of a controller object (such as an empty object), and applies it to the object as the “light” hits it.

Download an example.

Options

UV Map
  Which UV map to modify. Defaults to the active rendering layer.

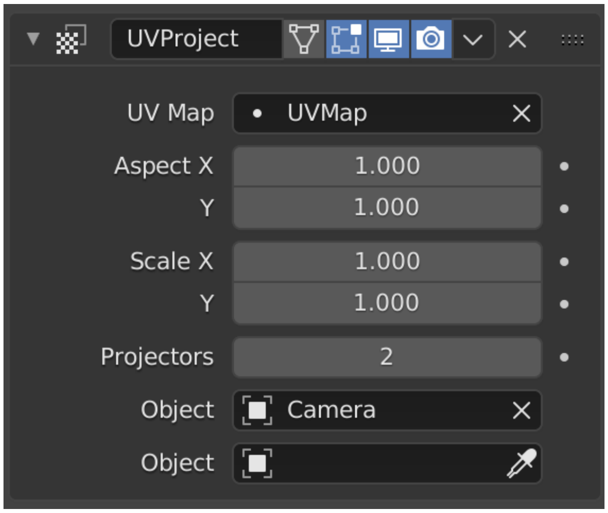
Aspect X/Y
  Changes the image’s aspect ratio. Only apply when a camera is used as projector object.

Scale X/Y

Scales the image. Only apply when a camera is used as projector object.

Projectors
: Up to ten projector objects are supported. Each face will choose the closest and aligned projector with its surface normal. Projections emit from the negative Z axis (i.e. straight down a camera or light). If the projector is a camera, the projection will adhere to its perspective/orthographic setting.

Object
: Specify the projector object(s).



UV Map: UVMap
Aspect X: 1.000
Y: 1.000
Scale X: 1.000
Y: 1.000
Projectors: 2
Object: Camera
Object:

The UV Project modifier.

Usage

General

UV Project is great for making spotlights more diverse, and also for creating decals to break up repetition.

Usually, an Image Texture node mapped to the UV map that the modifier targets is added to the object’s material.

Known Limitations

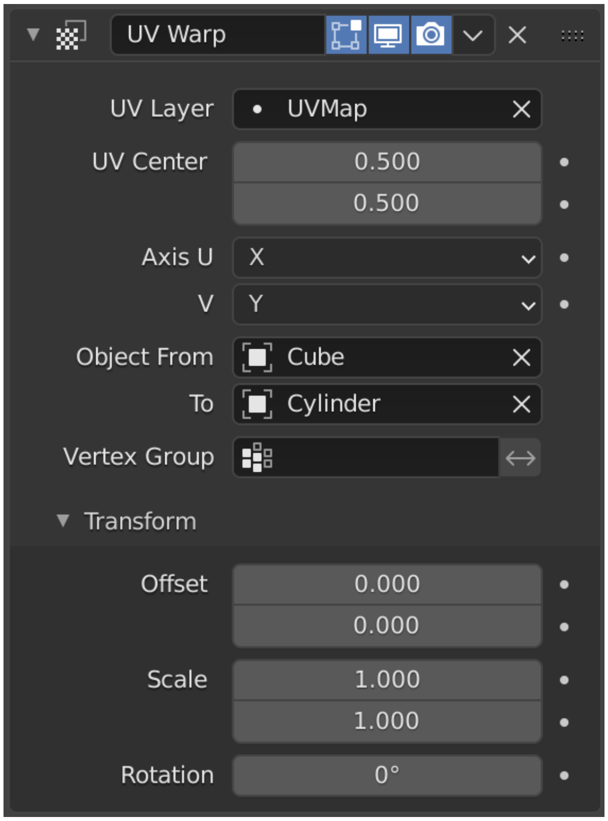
Vertices Behind the Camera

When projecting geometry in a perspective view, vertices behind the camera are not properly mapped. You can workaround this by subdividing geometry so that faces in front of the camera have correctly mapped UVs.

UV Warp Modifier

The *UV Warp* modifier transforms an object’s UV map based on values or two objects. Its purpose is to give you direct control over the object’s UVs in the 3D Viewport, allowing you to directly move, rotate, and scale existing UV coordinates using defined values or a controller object or bone.

Options



UV Warp

UV Layer: UVMap
UV Center: 0.500, 0.500
Axis U: X
V: Y
Object From: Cube
To: Cylinder
Vertex Group:

Transform

Offset: 0.000, 0.000
Scale: 1.000, 1.000
Rotation: 0°

UV Layer

Which UV map to modify; if not set it defaults to the active rendering layer.

UV Center

The center point of the UV map to use when applying scale or rotation. With (0, 0) at the bottom left and (1, 1) at the top right.

Axis U/V

The axes to use when mapping the 3D coordinates into 2D.

Object From, To

The two objects used to define the transformation. See Usage below.

Vertex Group

The vertex group can be used to scale the influence of the transformation per vertex.

Invert <->

Inverts the influence of the selected vertex group, meaning that the group now represents vertices that will not be deformed by the modifier.

The setting reverses the weight values of the group.

Transform

Offset

Amount to move the UV map.

Scale

Amount to scale the UV map.

Rotate

Amount to rotate the UV map.

Usage

How the UVs are warped is determined by the difference between the transforms (location, rotation and scale) of the *from* and *to* objects.

If the *to* object has the same transforms as the *from* object, the UVs will not be changed.

Assuming the *UV Axis* of the modifier is X/Y and the scale of the objects is (1, 1, 1), if the *to* object is one unit away from the *from* object on the X axis, the UVs will be transformed on the U axis (horizontally) by one full UV space (the entire width of the image).

Vertex Weight Edit Modifier

This modifier is intended to edit the weights of a vertex group.

The general process is the following, for each vertex:

- (Optional) It does the mapping, either through one of the predefined functions, or a custom mapping curve.
- It applies the influence factor, and optionally the vertex group or texture mask (0.0 means original weight, 1.0 means fully mapped weight).
- It applies back the weight to the vertex, and/or it might optionally remove the vertex from the group if its weight is below a given threshold, or add it if it is above a given threshold.

Important

This modifier does implicit clamping of weight values in the standard (0.0 to 1.0) range. All values below 0.0 will be set to 0.0, and all values above 1.0 will be set to 1.0.

Note

You can view the modified weights in Weight Paint Mode. This also implies that you will have to disable the *Vertex Weight Edit* modifier if you want to see the original weights of the vertex group you are editing.

Options

Vertex Group
    The vertex group to affect.

Default Weight

The default weight to assign to all vertices not in the given vertex group.

Group Add

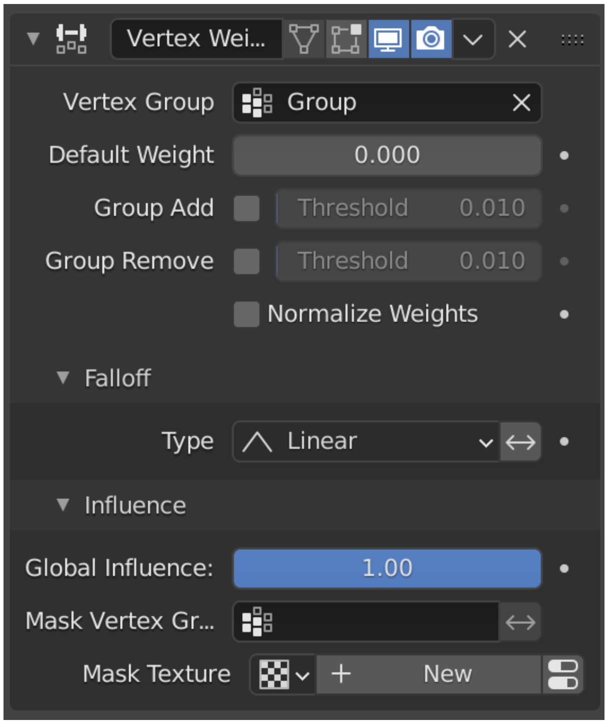
Adds vertices with a final weight over *Add Threshold* to the vertex group.

Group Remove

Removes vertices with a final weight below *Remove Threshold* from the vertex group.

Normalize Weights

Scale the weights in the vertex group to keep the relative weight but the lowest and highest values follow the full 0 - 1 range.



Vertex Wei...

Vertex Group: Group

Default Weight: 0.000

Group Add ☐ Threshold 0.010

Group Remove ☐ Threshold 0.010

☐ Normalize Weights

Falloff

Type: Linear

Influence

Global Influence: 1.00

Mask Vertex Gr...

Mask Texture: New

The Vertex Weight Edit modifier panel.

Falloff

Falloff Type

Type of mapping.

Linear

No mapping.

Custom Curve

Allows you to manually define the mapping using a curve.

Sharp, Smooth, Root and Sphere

These are classical mapping functions, from spikiest to roundest.

Random

Uses a random value for each vertex.

Median Step

Creates binary weights (0.0 or 1.0), with 0.5 as cutting value.

Invert <-->

Inverts the falloff.

Influence

Those settings are the same for the three *Vertex Weight* modifiers.

Global Influence

The overall influence of the modifier (0.0 will leave the vertex group's weights untouched, 1.0 is standard influence).

> **Important**
>
> Influence only affects weights, adding/removing of vertices to/from vertex group is not prevented by setting this value to 0.0.

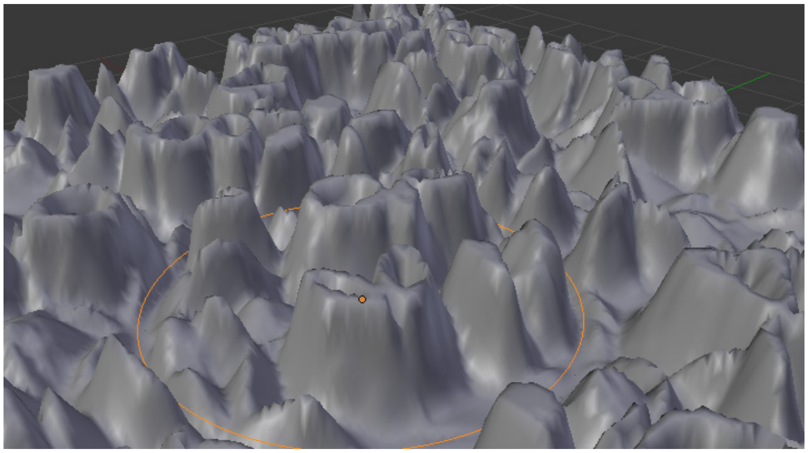
In addition, a per-vertex fine control of the effect is possible using either a vertex group or a texture (both are mutually exclusive). The per-vertex values from those will be multiplied with the *Global Influence*.

See common masking options for a complete reference.

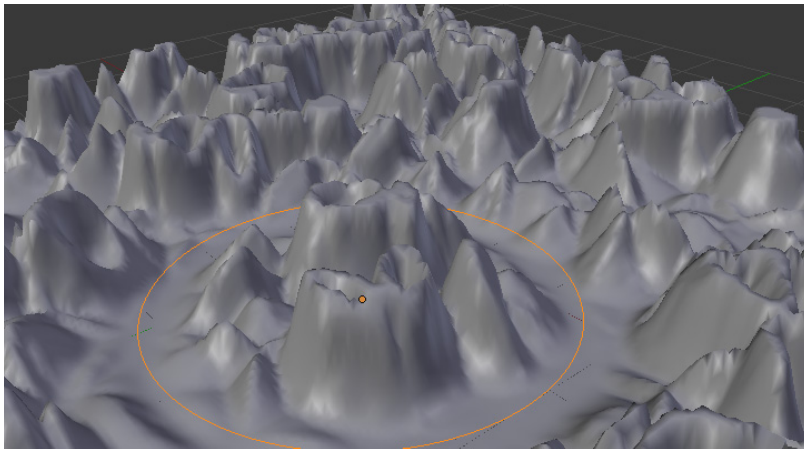
Example

Here is an example of various effects achieved using *Vertex Weight Edit* modifier (together with the Vertex Weight Proximity modifier) to generate weights used by the Displace modifier.

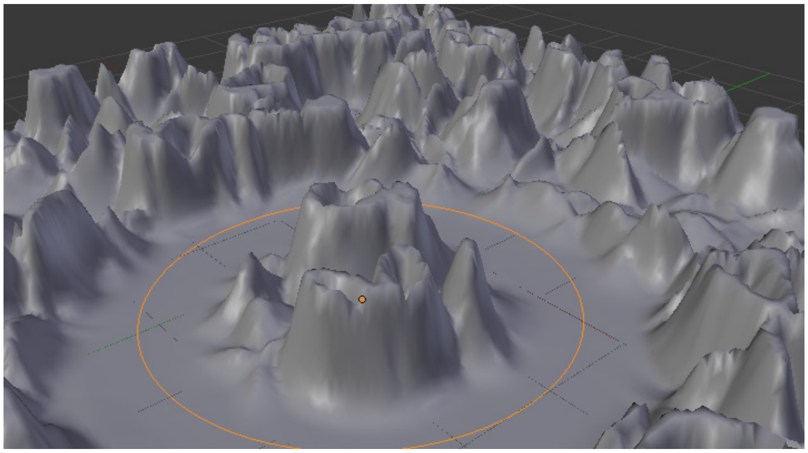
Curve Map variations.



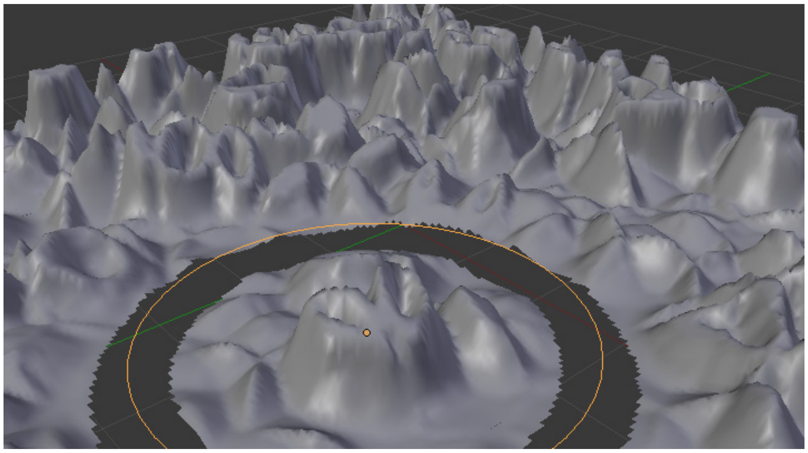
Concave-type mapping curve.



No mapping curve (linear).



Convex-type mapping curve.



Vertices with a computed weight below 0.1 removed from the vertex group.

Vertex Weight Mix Modifier

This modifier mixes a second vertex group (or a simple value) into the affected vertex group, using different operations.

Important

This modifier does implicit clamping of weight values in the standard (0.0 to 1.0) range. All values below 0.0 will be set to 0.0, and all values above 1.0 will be set to 1.0.

Note

You can view the modified weights in Weight Paint Mode. This also implies that you will have to disable the *Vertex Weight Mix* modifier if you want to see the original weights of the vertex group you are editing.

Options

Vertex Group A, B

- **A**: The vertex group to affect.
- **B**: The second vertex group to mix into the affected one. Leave it empty if you only want to mix in a simple value.

Invert Weights A/B

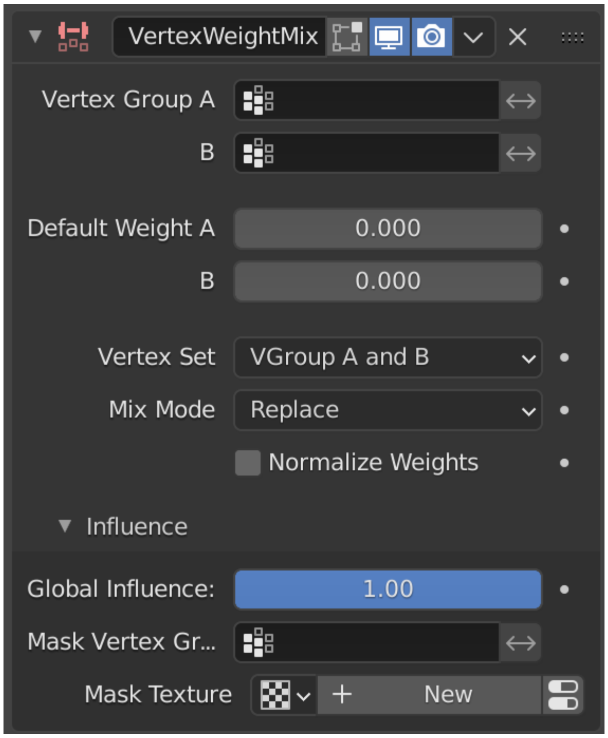
Invert the influence of the vertex group.

Default Weight A, B

- **A**: The default weight to assign to all vertices not in the given vertex group.
- **B**: The default weight to assign to all vertices not in the given second vertex group.

Vertex Set

Choose which vertices will be affected.



VertexWeightMix

Vertex Group A

B

Default Weight A 0.000

B 0.000

Vertex Set VGroup A and B

Mix Mode Replace

☐ Normalize Weights

Influence

Global Influence: 1.00

Mask Vertex Gr...

Mask Texture New

The Vertex Weight Mix modifier panel.

All::	Affects all vertices, disregarding the vertex groups content.
Vertex Group A::	Affects only vertices belonging to the affected vertex group.
Vertex Group B::	Affects only vertices belonging to the second vertex group.
Vertex Group A or B::	Affects only vertices belonging to at least one of the vertex groups.
Vertex Group A and B::	Affects only vertices belonging to both vertex groups.

Important

When using *All vertices*, *Vertices from group B* or *Vertices from one group*, vertices might be added to the affected vertex group.

Mix Mode

How the vertex group weights are affected by the other vertex group's weights.

Replace::	Replaces affected weights with the second group's weights.
Add::	Adds the values of *Group B* to *Group A*.
Subtract::	Subtracts the values of *Group B* from *Group A*.
Multiply::	Multiplies the values of *Group B* with *Group A*.
Divide::	Divides the values of *Group A* by *Group B*.
Difference::	Subtracts the smaller of the two values from the larger.
Average::	Adds the values together, then divides by 2.
Minimum::	Uses the smallest weight value of VGroup A's or VGroup B's weights.
Maximum::	Uses the largest weight value of VGroup A's or VGroup B's weights.

Normalize Weights

Scale the weights in the vertex group to keep the relative weight but the lowest and highest values follow the full 0 - 1 range.

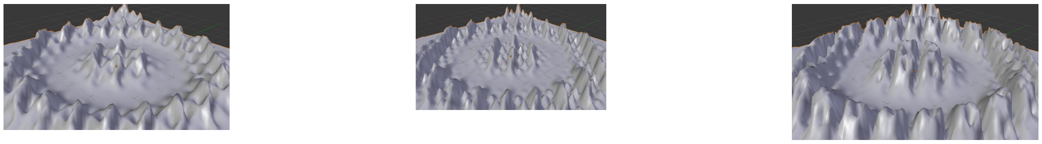
Influence

Those settings are the same for the three *Vertex Weight* modifiers, see the Vertex Weight Edit modifier page.

Example

Here is and example of using a texture and the mapping curve to generate weights used by the Wave modifier.

Texture channel variations.

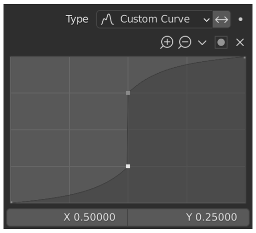


Using intensity.

Using Red.

Using Saturation.

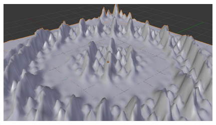
Custom mapping curve with a Vertex Weight Edit modifier.



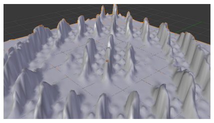
Type Custom Curve

X 0.50000 Y 0.25000

A customized mapping curve.



Custom Mapping disabled.



Custom Mapping enabled.

[The blend-file](), TEST_4 scene.

Vertex Weight Proximity Modifier

This modifier sets the weights of the given vertex group, based on the distance between the object (or its vertices), and another target object (or its geometry).

Warning

This modifier does implicit clamping of weight values in the standard (0.0 to 1.0) range. All values below 0.0 will be set to 0.0, and all values above 1.0 will be set to 1.0.

Note

You can view the modified weights in Weight Paint Mode. This also implies that you will have to disable the *Vertex Weight Proximity* modifier if you want to see the original weights of the vertex group you are editing.

Options

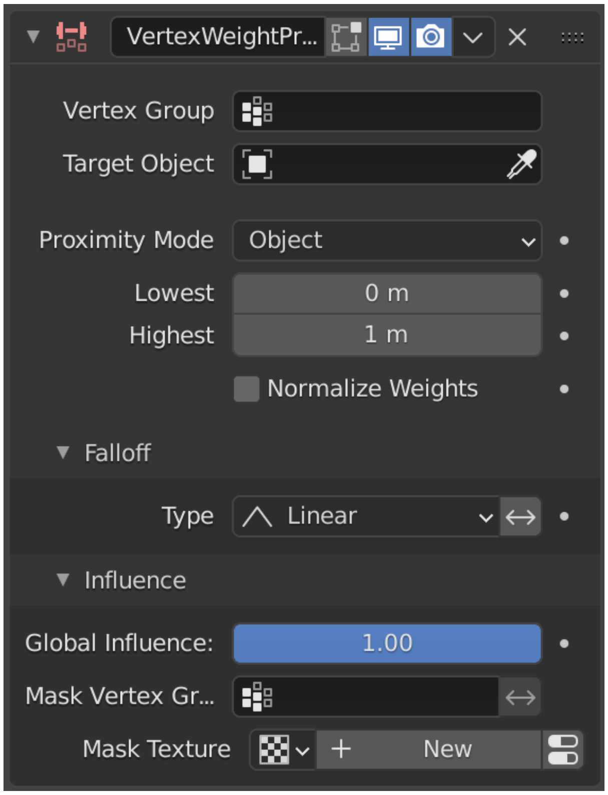
Vertex Group
  The vertex group to affect.

Target Object
  The object from which to compute distances.

Proximity Mode
  Object Distance
    Use the distance between the modified mesh object and the target object as weight for all vertices in the affected vertex group.

  Geometry Distance

Use the distance between each vertex and the target object, or its geometry.



Vertex Group

Target Object

Proximity Mode: Object

Lowest: 0 m

Highest: 1 m

☐ Normalize Weights

Falloff

Type: Linear

Influence

Global Influence: 1.00

Mask Vertex Gr...

Mask Texture

The Vertex Weight Proximity modifier panel.

Vertex

This will set each vertex’s weight from its distance to the nearest vertex of the target object.

Edge

This will set each vertex’s weight from its distance to the nearest edge of the target object.

Face

This will set each vertex’s weight from its distance to the nearest face of the target object.

Note

If you enable more than one of them, the shortest distance will be used. If the target object has no geometry (e.g. an empty or camera), it will use the location of the object itself.

Lowest

Distance mapping to 0.0 weight.

Highest

Distance mapping to 1.0 weight.

Tip

Lowest can be set above *Highest* to reverse the mapping.

Normalize Weights
Scale the weights in the vertex group to keep the relative weight but the lowest and highest values follow the full 0 - 1 range.

Falloff

Type
Type of mapping.

Linear
No mapping.

Custom Curve
Allows you to manually define the mapping using a curve.

Sharp, Smooth, Root and Sphere
These are classical mapping functions, from spikiest to roundest.

Random
Uses a random value for each vertex.

Median Step
Creates binary weights (0.0 or 1.0), with 0.5 as cutting value.

Invert <-->
Inverts the falloff.

Influence

Those settings are the same for the three *Vertex Weight* modifiers, see the Vertex Weight Edit modifier page.

Example

This example shows the usage of distance from a target object to dynamically control a Wave modifier with a modified vertex group:

The blend-file, TEST_1 scene.

Generate

- Array Modifier
- Bevel Modifier
- Boolean Modifier
- Build Modifier
- Decimate Modifier
- Edge Split Modifier
- Geometry Nodes Modifier
- Mask Modifier
- Mesh to Volume Modifier
- Mirror Modifier
- Multiresolution Modifier
- Remesh Modifier
- Screw Modifier
- Skin Modifier
- Solidify Modifier
- Subdivision Surface Modifier
- Triangulate Modifier
- Volume to Mesh Modifier
- Weld Modifier
- Wireframe Modifier

Array Modifier

The *Array* modifier creates an array of copies of the base object, with each copy being offset from the previous one in any of a number of possible ways. Vertices in adjacent copies can be merged if they are nearby, allowing smooth Subdivision Surface frameworks to be generated.

This modifier can be useful when combined with tileable meshes for quickly developing large scenes. It is also useful for creating complex repetitive shapes.

Multiple Array modifiers may be active for an object at the same time (e.g. to create complex three-dimensional constructs).

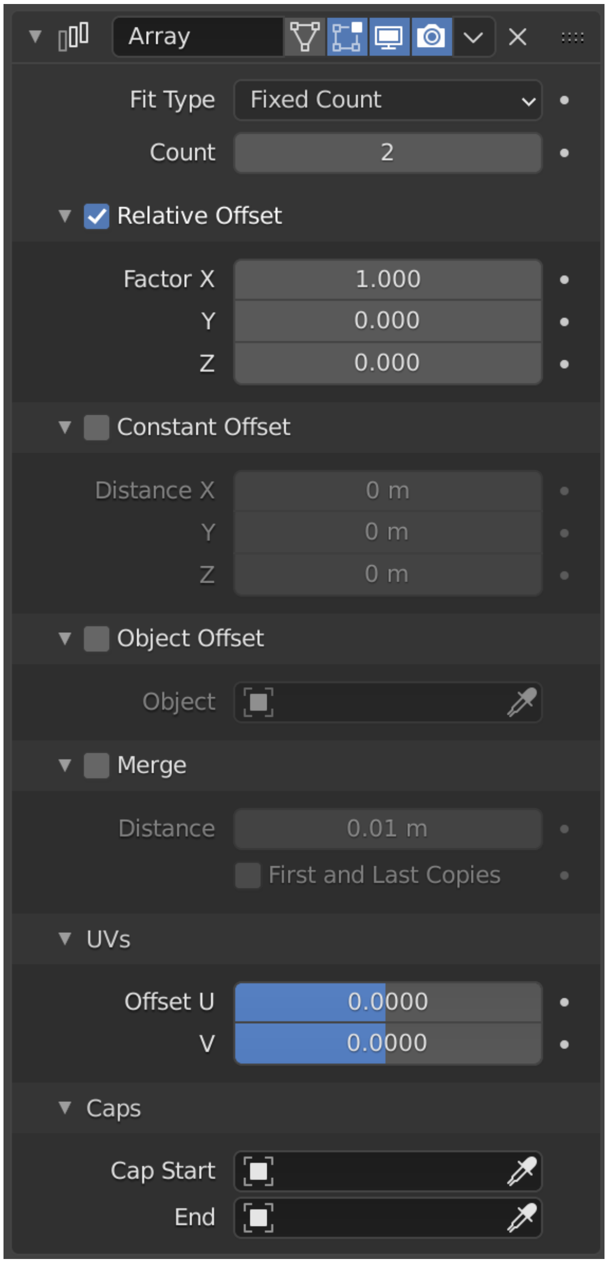
Options

Fit Type

> Controls how the length of the array is determined. There are three choices, activating respectively the display of the *Curve*, *Length* or *Count* settings explained below:
>
> Fit Curve
>
> > Generates enough copies to fit within the length of the curve object specified in *Curve*.
>
> Fit Length
>
> > Generates enough copies to fit within the fixed length given by *Length*.
>
> Fixed Count
>
> > Generates the number of copies specified in *Count*.

Note

- Both *Fit Curve* and *Fit Length* use the local coordinate system size of the base object, which means that scaling the base object in Object Mode will not change the number of copies generated by the modifier.
- *Fit Curve* uses the local coordinate system length of the curve, which means that scaling the curve in Object Mode will not change the number of copies generated by the modifier.
- Applying the scale can be useful for both.



Array

Fit Type Fixed Count

Count 2

☑ Relative Offset

Factor X 1.000

Y 0.000

Z 0.000

☐ Constant Offset

Distance X 0 m

Y 0 m

Z 0 m

☐ Object Offset

Object

☐ Merge

Distance 0.01 m

☐ First and Last Copies

UVs

Offset U 0.0000

V 0.0000

Caps

Cap Start

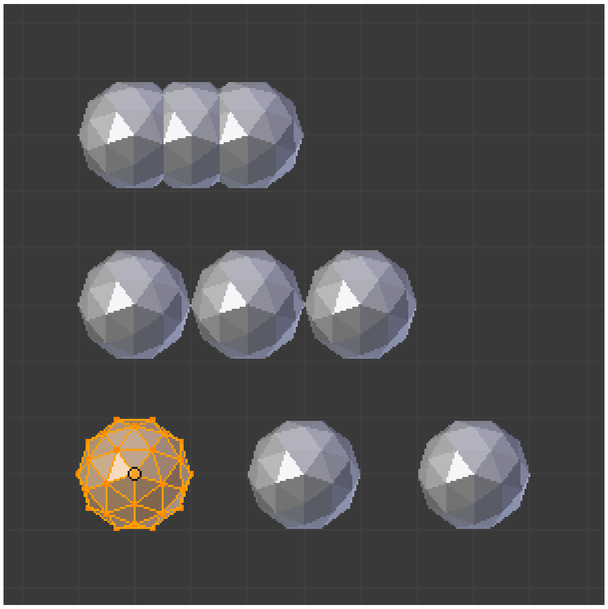
End

The Array modifier.

Relative Offset

Factor X/Y/Z

Adds a translation equal to the object’s bounding box size along each axis, multiplied by a scaling factor, to the offset. X, Y and Z scaling factors can be specified.



Relative offset (0.5, 1.0 and 1.5) examples.

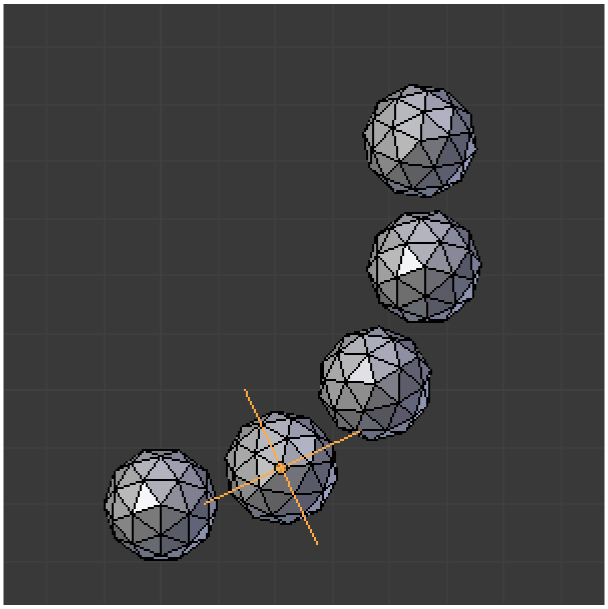
Constant Offset

Distance X/Y/Z

Adds a constant translation component to the duplicate object's offset. X, Y and Z constant components can be specified.

Object Offset

Adds a transformation taken from an object (relative to the current object) to the offset. It is good practice to use an empty object centered or near to the initial object. E.g. by rotating this empty a circle or helix of objects can be created.



Object offset example.

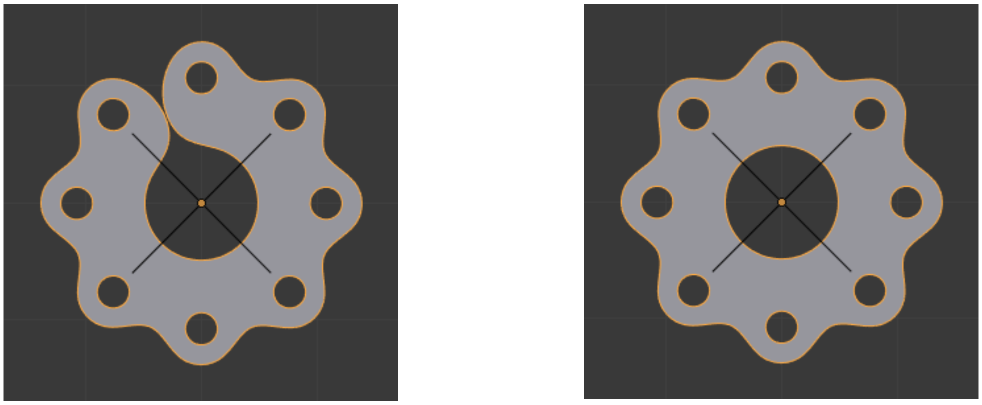
Merge

If enabled, vertices in each copy will be merged with vertices in the next copy that are within the given *Distance*.

First and Last Copies

> If enabled **and** *Merge* is enabled, vertices in the first copy will be merged with vertices in the last copy, again if they are within *Distance* range. This is useful for circular objects.

First and Last Copies merge example.



Subdivision discontinuity caused by not merging vertices between first and last copies (*First and Last Copies* off).	Subdivision discontinuity eliminated by merging vertices between first and last copies (*First and Last Copies* on).

Distance

Controls the merge distance for *Merge* and *First and Last Copies*.

UVs

Offset U/V

Shifts UVs of each new duplicate by a settable amount.

Caps

Cap Start, End

This allows either endpoints of the array to have a different mesh subsisted.

For the *start*: as if it was in position -1, i.e. one “array step” before the first “regular” array copy. For the *end*: as if it was in position $n + 1$, i.e. one “array step” after the last “regular” array copy.

When *Merge* is activated, the *cap* vertices within the *Distance* threshold will be merged.

Note

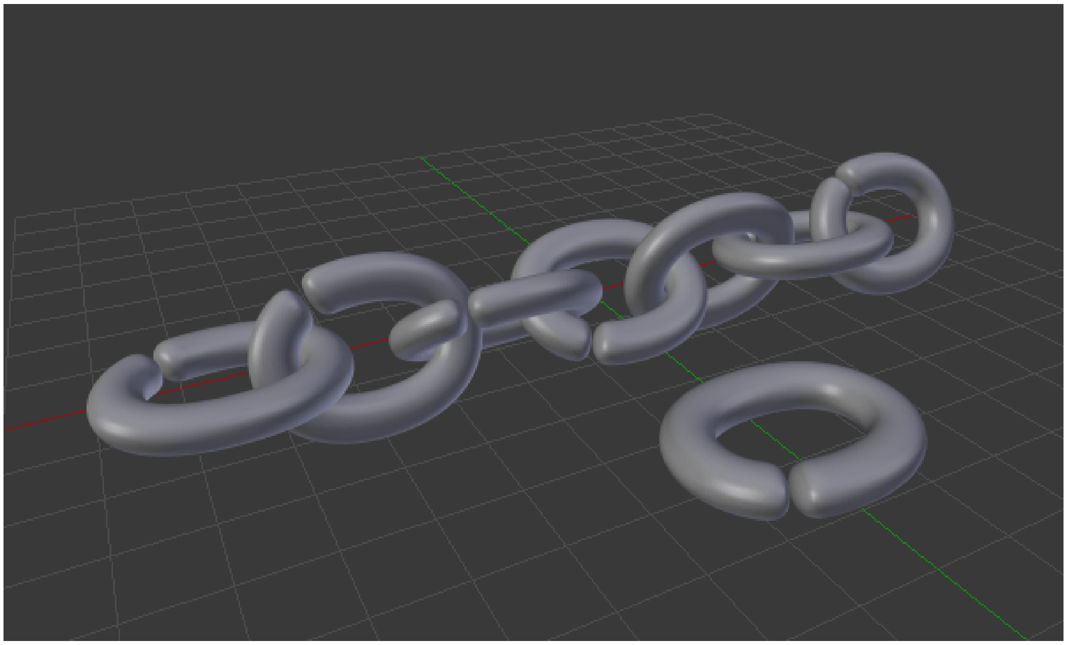
The start/end cap objects currently do not support the *First and Last Copies* option.

Hints

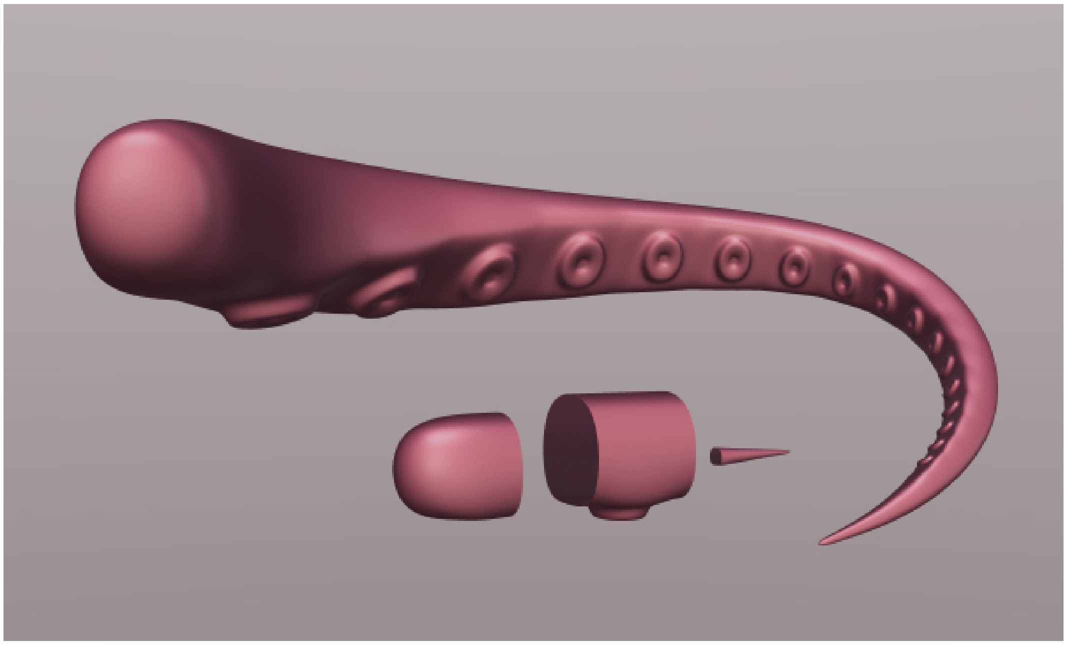
Offset Calculation

The transformation applied from one copy to the next is calculated as the sum of the three different components (*Relative*, *Constant* and *Object*), each of which can be enabled/disabled independently of the others. This allows, for example, a relative offset of (1.0, 0.0, 0.0) and a constant offset of (0.1, 0.0, 0.0), giving an array of objects neatly spaced along the X axis with a constant 0.1 unit between them, whatever the original object's size.

Examples



A chain created from a single link. Sample blend-file.

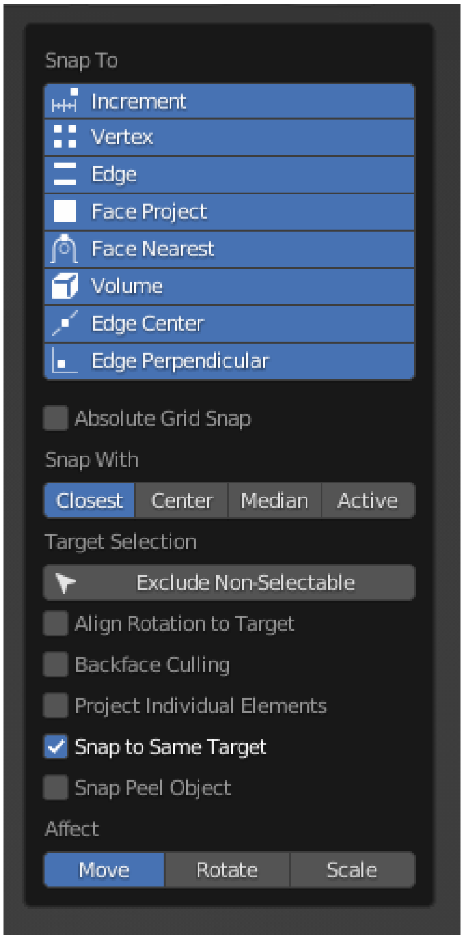


A tentacle created with an Array Modifier followed by a Curve Modifier.

The segment in the foreground is the base mesh for the tentacle; the tentacle is capped by two specially-modeled objects deformed by the same Curve object as the main part of the tentacle. Sample blend-file.

Fractal

Multi-level array animated with motion blur.



Snap To

- Increment
- Vertex
- Edge
- Face Project
- Face Nearest
- Volume
- Edge Center
- Edge Perpendicular

☐ Absolute Grid Snap

Snap With

Closest | Center | Median | Active

Target Selection

Exclude Non-Selectable

☐ Align Rotation to Target

☐ Backface Culling

☐ Project Individual Elements

☑ Snap to Same Target

☐ Snap Peel Object

Affect

Move | Rotate | Scale

Fractal created with multiple arrays. Sample blend-file.

Bevel Modifier

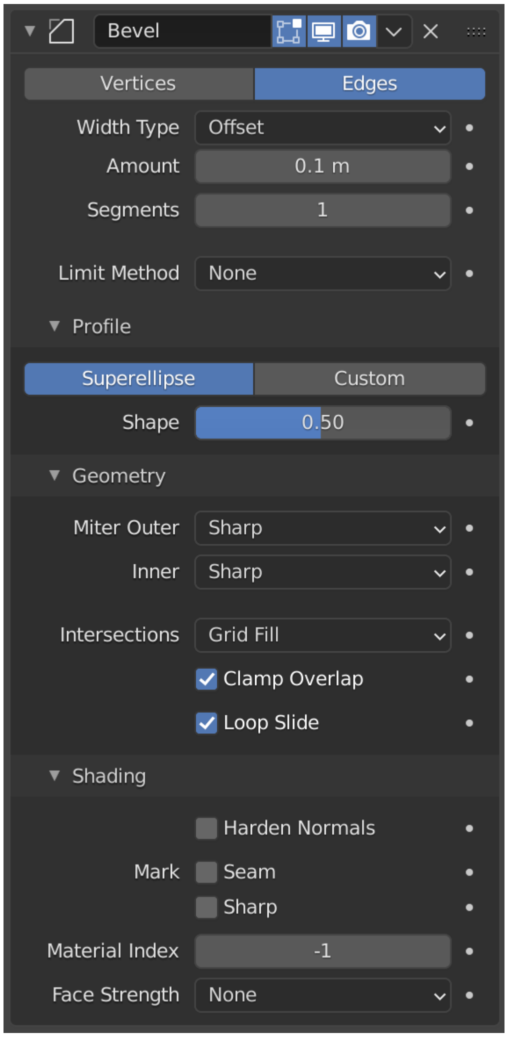
The *Bevel* modifier bevels the edges of the mesh it is applied to, with some control of how and where the bevel is applied to the mesh.

It is a non-destructive alternative to the Bevel Operation in Edit Mode.

Side views of a cube.

Not beveled.

Beveled.



Bevel

Vertices | Edges

Width Type: Offset

Amount: 0.1 m

Segments: 1

Limit Method: None

Profile

Superellipse | Custom

Shape: 0.50

Geometry

Miter Outer: Sharp

Inner: Sharp

Intersections: Grid Fill

☑ Clamp Overlap

☑ Loop Slide

Shading

☐ Harden Normals

Mark ☐ Seam

☐ Sharp

Material Index: -1

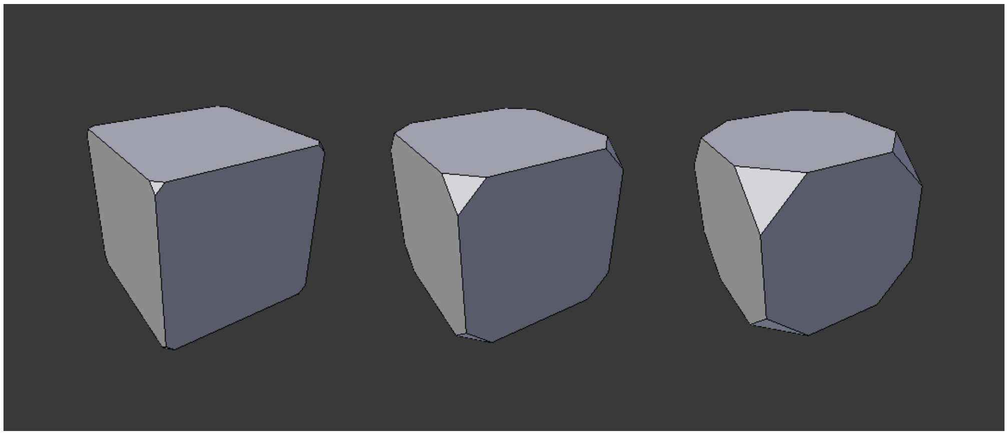
Face Strength: None

The Bevel modifier.

Options

Affect

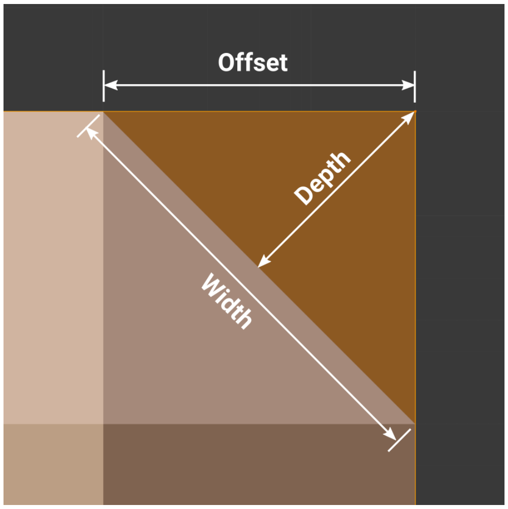
Vertices::	Only the areas near vertices are beveled, the edges remain unchanged.
Edges::	Bevel the edges, creating intersections at vertices.



Three cubes with 0.1, 0.3 and 0.5 bevel widths, with *Vertices* option selected.

Width Type

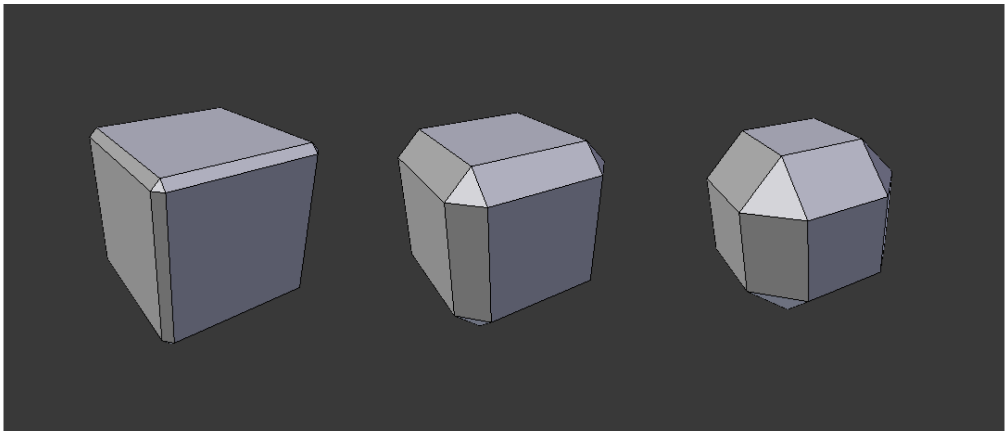
Defines how *Width* will be interpreted to determine the amount of bevel.



Offset::	The distance from the new edge to the original.
Width::	The distance between the two new edges formed by the bevel (or the edges on either side of the bevel if there is more than one segment).
Depth::	Value is the perpendicular distance from the new bevel face to original edge.
Percent::	The percentage of the length of adjacent edge length that the new edges slide along.
Absolute::	The exact distance along edges adjacent to the beveled edge. A difference from **Offset** is visible when the unbeveled edges attached to beveled edges meet at an angle besides a right angle.

Width

The size of the bevel effect. See *Width Method* below.



Three Cubes with 0.1, 0.3 and 0.5 bevel widths.

Segments

The number of edge loops added along the bevel's face.

Limit Method

Used to control where a bevel is applied to the mesh.

None::	No limit, all edges will be beveled.
Angle::	Only bevels edges whose angle of adjacent face normals plus the defined *Angle* is less than 180 degrees. Intended to allow you to bevel only the sharp edges of an object without affecting its smooth surfaces.
Weight::	Use an attribute to determine the width of a bevel. When the bevel weight is 0.0, no bevel is applied. Any attribute on the input mesh can be chosen. By default the *bevel_weight_edge* and *bevel_weight_vert* attributes adjusted in edit mode are used. For convenience, the modifier lists the attributes from the original mesh in the dropdown, but attributes created by previous modifiers can also be used. Attributes with non-

matching domains or types will be automatically interpolated to the correct type.

Vertex Group:: Use weights from a vertex group to determine the width of the bevel. When the vertex weight is 0.0, no bevel is applied. An edge is only beveled if both of its vertices are in the vertex group. See here about adjusting vertex group weights.

Invert <–>

Inverts the influence of the selected vertex group, meaning that the group now represents vertices that will not be deformed by the modifier.

The setting reverses the weight values of the group.

Profile

Superellipse

Creates a bevel with a uniform concave or convex curve.

Shape

The shape of the bevel, from concave to convex. It has no effect if *Segments* is less than 2.

Custom Profile

This widget allows the creation of a user-defined profile with more complexity than with the single profile parameter. The modal tool allows toggling the custom profile, but the shape of the profile is only editable in the options panel after the operation is confirmed.

The profile starts at the bottom right of the widget and ends at the top left, as if it were between two edges meeting at a right angle. Control points are created in the widget and then the path is sampled with the number of segments from the Bevel modifier.

Miter Shape

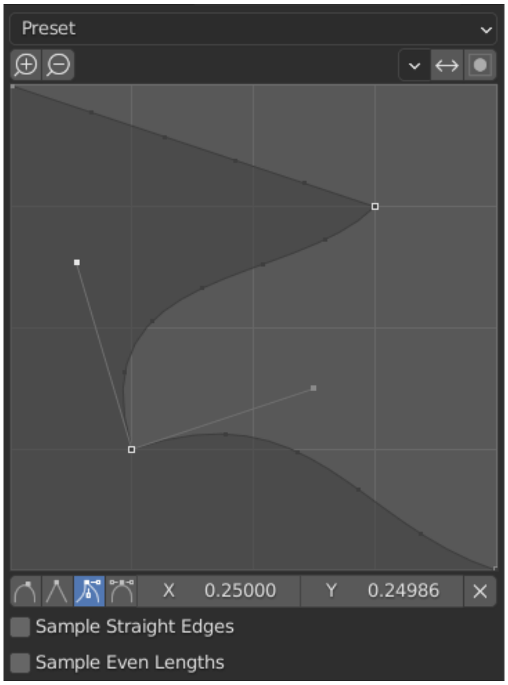
The shape of the miter patterns, from concave to convex. It has no effect if *Segments* is less than 2.

Note

The *Miter Shape* slider stays active when miters are enabled because it still controls the shape of the miter profiles.

Presets

The *Support Loops* and *Steps* presets are built dynamically depending on the number of segments in the bevel. If the number of segments is changed, the preset will have to be re-applied.



X 0.25000 Y 0.24986

☐ Sample Straight Edges

☐ Sample Even Lengths

The custom profile widget.

Sampling

Samples will first be added to each control point, then if there are enough samples, they will be divided evenly between the edges. The *Sample Straight Edges* option toggles whether the samples are added to edges with sharp control points on either side. If there aren’t enough samples to give each edge the same number of samples, they will just be added to the most curved edges, so it is recommended to use at least as many segments as there are control points.

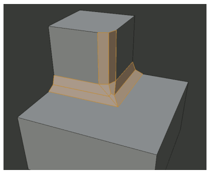
Geometry

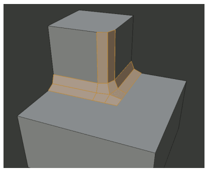
Miter Inner/Outer

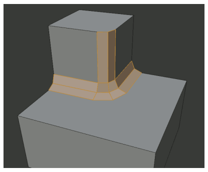
A *miter* is formed when two beveled edges meet at an angle. On the side where the angle is greater than 180 degrees, if any, it is called an *outer miter*. If it is less than 180 degrees, then it is called an *inner miter*. The outer and inner miters can each be set to one of these patterns:

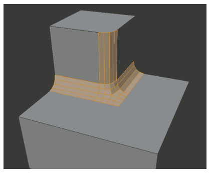
Sharp::	Edges meet at a sharp point, with no extra vertices introduced on the edges.
Patch::	Edges meet at a sharp point but in addition, two extra vertices are introduced near the point so that the edges and faces at the vertex may be less pinched together than what occurs in the *Sharp* case. This pattern does makes no sense for inner miters, so it behaves like *Arc* for them.
Arc::	Two vertices are introduced near the meeting point, and a curved arc joins them together. The *Spread* slider controls how far the new vertices are from the meeting point. The *Profile* curve widget controls the shape of the arc.

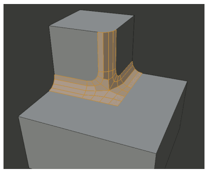
Diagrams of the miter patterns.


Sharp outer miter.


Patch outer miter.


Arc outer miter.


Sharp inner miter.


Arc inner miter.

Spread

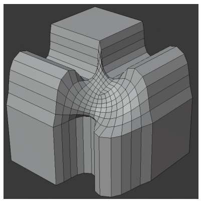
The value used to spread extra vertices apart for non-sharp miters. This option is available when Miter Inner is set to Arc.

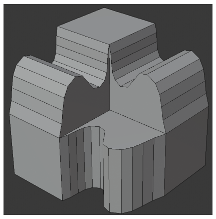
Intersections

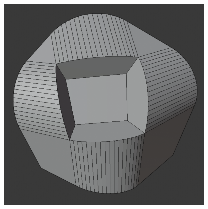
When more than two beveled edges meet at a vertex, a mesh is created as a way to complete the intersection between the generated geometry. This option controls the method used to create that mesh.

Grid Fill::	The default method for building intersections, useful when a smooth continuation of the bevel profile is desired. Without *Custom Profile* enabled, the curve of the profile continues through the intersection, but with a custom profile it just creates a smooth grid within the boundary of the intersection.
Cutoff::	Creates a cutoff face at the end of each beveled edge coming into the vertex. This is most useful for custom profiles when the new intersection is too complex for a smooth grid fill. With a three way intersection, when the inner corners of the cutoff profiles faces meet at the same location, no center face is created. The direction of the cutoff faces depends on the original vertex's normal.

Intersection method options.


Grid fill intersection method.


Three way cutoff intersection where the inner vertices are merged.


Cutoff intersection method with a center face.

Clamp Overlap

Limits the width of each beveled edge so that edges cannot cause overlapping intersections with other geometry.

Loop Slide
: If there are unbeveled edges along with beveled edges into a vertex, the bevel tries to slide along those edges when possible. Turning the option off can lead to more even bevel widths.

Shading

Harden Normals
: When enabled, the per-vertex face normals of the bevel faces are adjusted to match the surrounding faces, and the normals of the surrounding faces are not affected. This will keep the surrounding faces flat (if they were before), with the bevel faces shading smoothly into them. For this effect to work, a mesh must have custom split normals. As a convenience, that option will be enabled for you if it is not already when you enable Harden Normals here.

Mark
: Seam
: If a seam edge crosses a non-seam one and you bevel all of them, this option will maintain the expected propagation of seams.

: Sharp
: Similar to Mark Seams, but for sharp edges.

Material Index
: The index of the material slot to use for the bevel. When set to -1, the material of the nearest original face will be used.

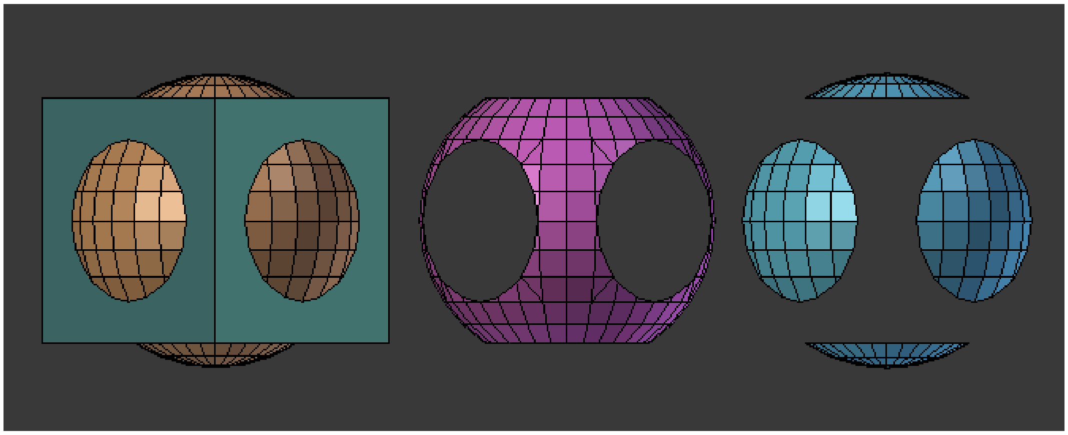
Face Strength
: Set *Face Strength* on the faces involved in the bevel, according to the mode specified here. This can be used in conjunction with a following Weighted Normals modifier (with the *Face Influence* option checked).

None::	Do not set face strength.
New::	

	Set the face strength of new faces along edges to *Medium*, and the face strength of new faces at vertices to *Weak*.
Affected::	In addition to those set for the *New* case, also set the faces adjacent to new faces to have strength *Strong*.
All::	In addition to those set for the *Affected* case, also set all the rest of the faces of the model to have strength *Strong*.

Boolean Modifier

The *Boolean* modifier performs operations on meshes that are otherwise too complex to achieve with as few steps by editing meshes manually. It uses one of the three available Boolean operations to create a single mesh out of two mesh objects:



The Union, Intersection and Difference between a Cube and a UV Sphere, with the modifier applied to the sphere and using the cube as target.

This modifier needs a second mesh object, or collection of mesh objects, to be the target (the second operand) of the operation.

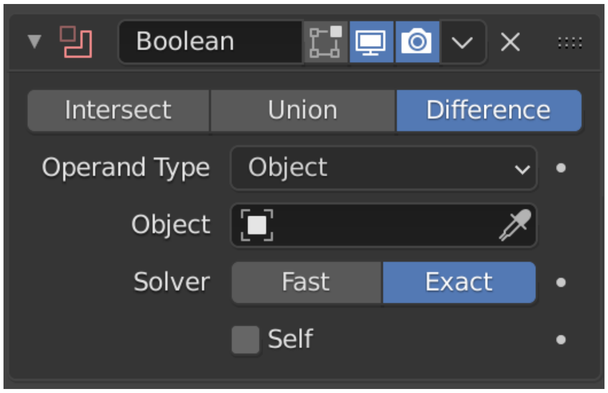
Warning

Only Manifold meshes are guaranteed to give proper results, other cases (especially "opened" meshes, Non-manifold but without any self-intersections) will usually work well, but might give odd glitches and artifacts in some cases.

Tip

If you have marked your objects to show the edges (in *Properties* ▸ *Object Properties* ▸ *Viewport Display*, enable *Wireframe*), you will see the edge creation process while you are moving your objects around. Depending on your mesh topology, you can also enable X-Ray and Transparency and see the topology being created in real-time.

Options



The Boolean modifier.

Operation

Intersect::	Everything inside both the target mesh and the modified mesh is kept. If the target is a collection, then only the inside of *all* meshes is kept.
Union::	The target mesh or collection is added to the modified mesh, removing any interior faces.
Difference::	The target mesh, or collection of meshes, is subtracted from the modified mesh (everything *outside* of the target mesh or collection is kept).

Operand Type

Choose the type of the operand (target).

Object::	The target is a mesh object.
Collection::	

	The target is a collection. When the target is a collection and the Solver is Fast, the Intersect operation is not allowed.

Object

The name of the target mesh object.

Collection

The name of the target collection (may be empty if Solver is Exact, which can be useful in combination with the Self option).

Solver

Algorithm used to calculate the Boolean intersections.

Fast::	Uses a mathematically simple solver which offers the best performance; however, this solver lacks support for overlapping geometry.
Exact::	Uses a mathematically complex solver which offers the best results and has full support for overlapping geometry; however, this solver is much slower than the *Fast Solver*.

Solver Options

Materials *Exact Solver*

Method for setting materials on the new faces.

Index Based::	Set the material on new faces based on the order of the material slot lists. If a material doesn't exist on the modifier object, the face will use the same material slot or the first if the object doesn't have enough slots.
Transfer::	Transfer materials from non-empty slots to the result mesh, adding new materials as necessary. For empty slots, fall back to using the same material index as the operand mesh.

Self Intersection *Exact Solver*

Correctly calculates cases when one or both operands have self-intersections, this involves more calculations making it slower.

Hole Tolerant *Exact Solver*

Optimizes the Boolean output for Non-manifold geometry at the cost of increased computational time. Because of the performance impact, this option should only be enabled when the *Exact* solver demonstrates errors with non-manifold geometry.

Overlap Threshold *Fast Solver*

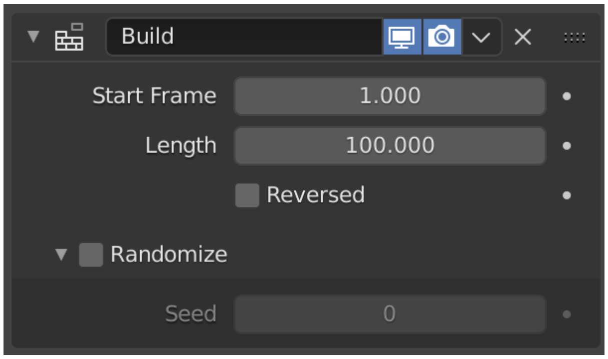
Maximum distance between two faces to consider them as overlapping. This helps solve the limitation of this solver, if the Boolean result seems unexpected try using the exact solver.

Build Modifier

The *Build* modifier causes the faces of the mesh object to appear or disappear one after the other over time.

By default, faces appear in the order in which they are stored in memory (by default, the order of creation). The face/vertex order can be altered in Edit Mode by using Sort Mesh Elements.

Options



Start Frame 1.000

Length 100.000

☐ Reversed

☐ Randomize

Seed 0

The Build modifier.

Start Frame
: The start frame of the building process.

Length
: The number of frames over which to rebuild the object.

Reversed
: The modifier will operate in reverse, essentially allowing it to be used as a "deconstruction" effect. This is useful for making a set of instancing objects gradually disappear.

Randomize

Randomizes the order in which the faces are built.

Seed
: The random seed. Changing this value gives a different "random" order when *Randomize* is checked. This order is always the same for a given seed/mesh set.

Example

The Build modifier can be used to make a large number of items to progressively appear, without resorting to animating the visibility of each one by one. Examples of this include a mesh containing vertices only, which is used as an Instancing Vertex emitter, and has the Build modifier on it. Such a setup is a workaround/technique for being able to art-direct a semi-random layout of a collection of objects (e.g. leaves/balls forming a carpet). This can be preferable to particles e.g. due to undesirable distribution of items leaving random gaps and overlapping in other places.

Decimate Modifier

The *Decimate* modifier allows you to reduce the vertex/face count of a mesh with minimal shape changes.

This is not usually used on meshes which have been created by modeling carefully and economically (where all vertices and faces are necessary to correctly define the shape). But if the mesh is the result of complex modeling, sculpting and/or applied Subdivision Surface/ Multiresolution modifiers, the *Decimate* one can be used to reduce the polygon count for a performance increase, or simply remove unnecessary vertices and edges.

Unlike the majority of existing modifiers, this one does not allow you to visualize your changes in Edit Mode.

The modifier displays the number of remaining faces as a result of the *Decimate* modifier.

Options

Collapse

Merges vertices together progressively, taking the shape of the mesh into account.

Ratio

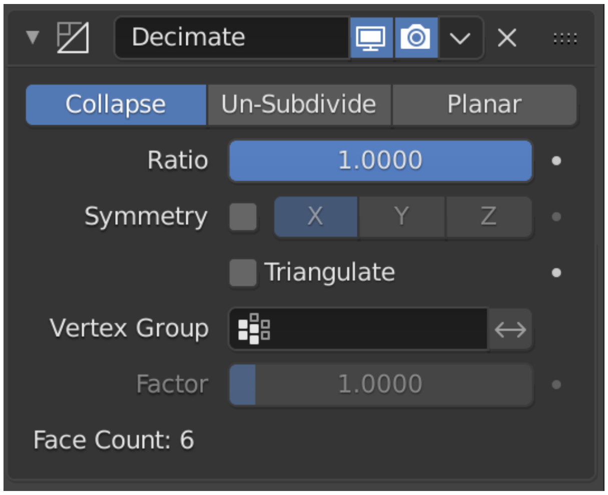
The ratio of faces to keep after decimation.

- On 1.0: the mesh is unchanged.
- On 0.5: edges have been collapsed such that half the number of faces remain (see note below).
- On 0.0: all faces have been removed.

Note

Although the *Ratio* is directly proportional to the number of remaining faces, triangles are used when calculating the ratio.

This means that if your mesh contains quads or other polygons, the number of remaining faces will be larger than expected, because those will remain unchanged if their edges are not collapsed.



Ratio 1.0000

Factor 1.0000

Face Count: 6

The Decimate modifier in Collapse mode.

This is only true if the *Triangulate* option is disabled.

Symmetry
: Maintains symmetry on a single axis.

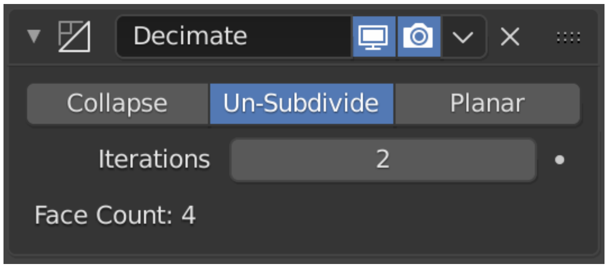
Triangulate
: Keeps any resulting triangulated geometry from the decimation process.

Vertex Group
: A vertex group that controls what parts of the mesh are decimated.

Factor
: The amount of influence the *Vertex Group* has on the decimation.

Un-Subdivide

It can be thought of as the reverse of subdivide. It attempts to remove edges that were the result of a subdivide operation. It is intended for meshes with a mainly grid-based topology (without giving uneven geometry). If additional editing has been done after the subdivide operation, the results may be unexpected.


Decimate
Collapse
Un-Subdivide
Planar

Iterations 2

Face Count: 4

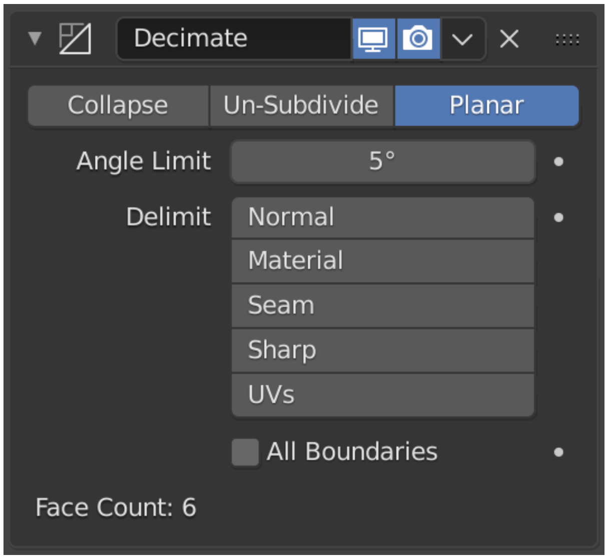
The Decimate modifier in Un-Subdivide mode.

Iterations

The number of times to perform the un-subdivide operation. Two iterations is the same as one subdivide operation, so you will usually want to use even numbers.

Planar

It reduces details on forms comprised of mainly flat surfaces.


Decimate
Collapse
Un-Subdivide
Planar
Delimit
Normal
Material
Seam
Sharp
UVs

Angle Limit 5°

☐ All Boundaries

Face Count: 6

The Decimate modifier in Planar mode.

Angle Limit

Dissolve geometry which form angles (between surfaces) higher than this setting.

Delimit

Prevent dissolving geometry in certain places.

Normal

Does not dissolve edges on the borders of areas where the face normals are reversed.

Material

Does not dissolve edges on the borders of where different materials are assigned.

Seam
Does not dissolve edges marked as seams.

Sharp
Does not dissolve edges marked as sharp.

UVs
Does not dissolve edges that are part of a UV map.

All Boundaries
When enabled, all vertices along the boundaries of faces are dissolved. This can give better results when using a high *Angle Limit*.

Edge Split Modifier

The *Edge Split* modifier splits, duplicates edges within a mesh, breaking ‘links’ between faces around those split edges.

The edges to split can be determined from the edge angle (i.e. angle between faces forming that edge), and/or edges marked as sharp.

Splitting an edge affects vertex normal generation at that edge, making the edge appear sharp. It can also be used for manual control of the smoothing process, where the user defines which edges should appear smooth or sharp (see Mesh Smoothing for other ways to do this). If desired, both modes can be active at once.

Note

This modifier is kept mostly for historical/compatibility reasons. Everything it can do in shading, and much more, can now be achieved using custom normals.

Unless you really need the topology changes it generates, it is not advised to use it in new projects.

Note

Splitting edges can also be performed manually in Edit Mode.

Options

Edge Angle

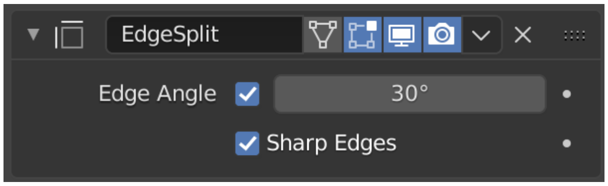
When enabled, an edge will be split if the angle between its two adjacent faces is greater than the *Split Angle*.

Split Angle

On 0: all edges are split. On 180: no edges are split.

Sharp Edges

When enabled, edges will be split if they were marked as sharp.


EdgeSplit

Edge Angle ☑ 30°

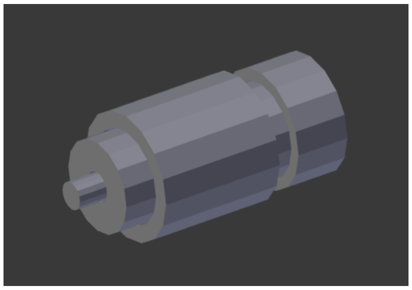
☑ Sharp Edges

The Edge Split modifier.

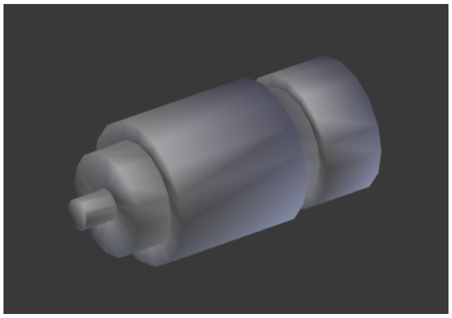
Note

Non-manifold edges will always be split.

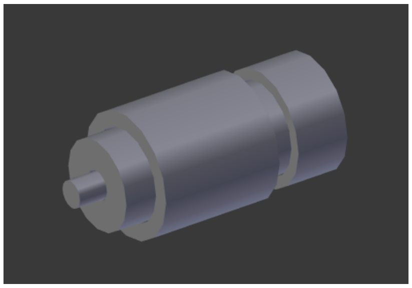
Examples



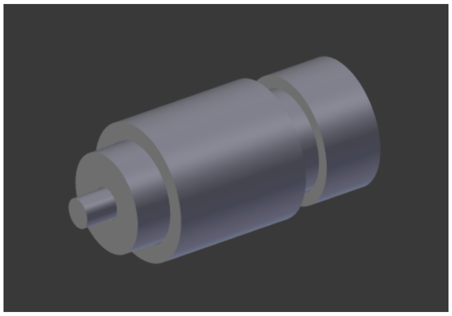
Flat shading.



Smooth shading.



Smooth shading with Edge Split.

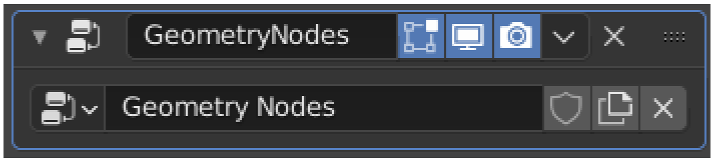


Smooth shading with Edge Split and Subdivision

Surface.

Geometry Nodes Modifier

The *Geometry Nodes* modifier creates a modifier with a node group which defines its functionality.



A new Geometry Nodes modifier with a new node group.

This modifier is supported by mesh, curve, text, and volume objects.

Options

Node Group

A Node Group with the geometry input and output. Those are respectively what is received and passed to the previous and next modifier in the stack. See Nodes for all available nodes.

Inputs

A list of the node group's inputs which can have unique values even if the group is shared among multiple modifiers.

If the input is connected to a Field socket, there will be a toggle to switch between using a single value for the input or using an attribute on the input geometry. Using an attribute for input means the value can be different for every element.

The attribute name used by default when using the node group in a modifier for the first time is defined in the node group inputs panel.

Note

The attribute domain and the used to access the attribute is defined by the node the input is connected to.

Warnings

Nodes that show a warning message in the node editor will also show that message here.

Custom warning messages can be created using the Warning Node.

Output Attributes

By connecting a field socket to the group output node, you can create custom Attributes from a Field output of any node in the node tree. The domain of the attribute must be specified in the group node’s output properties. Note, this does not work with Instanced Data.

The attribute name used by default when using the node group in a modifier for the first time is defined in the node group outputs panel.

This panel is hidden unless output node has attribute sockets.

Manage

Bake

Bake Target

Specifies where baked data should be stored. This can be overridden for individual bakes.

Packed::	The baked data is packed into the .blend file. So no separate file is necessary.
Disk::	The baked data is stored in a separate directory on disk.

Bake Path

Location on disk where the baked data for Simulation Zones and Bake Nodes are stored.

See also

Geometry Node Baking

Named Attributes

This panel displays information about all custom named attributes used by the node group. More information is available in the geometry nodes inspection page.

Move to Nodes Operator

Creates a new geometry node tree with the name of the current node tree with `.wrapper` appended to the name. This operation moves all inputs and outputs from the old modifier into a new node group. In order for this operator to function, there **must** be a Group Input **and** a Group Output each with a Geometry socket attached to the node group. This action causes all *Output Attributes* to become *Internal Dependencies* utilizing the Store Named Attribute Node. All modifier “inputs” will then also become inputs of the newly created node group.

This operator is useful to easily allow a node tree to be reused in other trees or to mark it as an Asset to be reused in other projects.

Mask Modifier

The *Mask* modifier allows vertices of an object to be hidden dynamically based on vertex groups.

Options

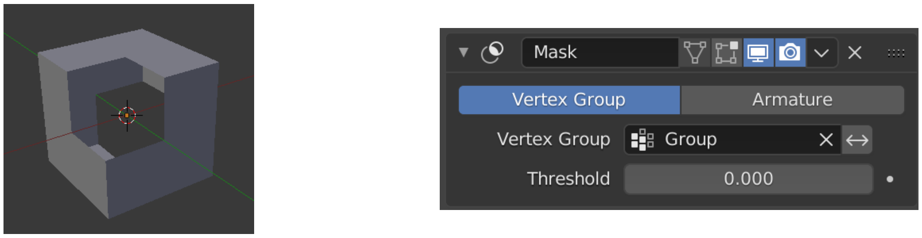
Mode

The Mask Modifier can hide parts of a mesh based on two different modes, selectable from this select menu.

Vertex Group

Hides all vertices not included in the chosen vertex group.

The Mask modifier in Vertex Group mode.



Vertex Group: Group

Threshold: 0.000

Armature

When in Pose Mode, vertices belonging to the vertex group associated with the active bone (same names) will be visible. Vertices not in that group will be hidden.

The Mask modifier in Armature mode.

Mesh to Volume Modifier

Reference

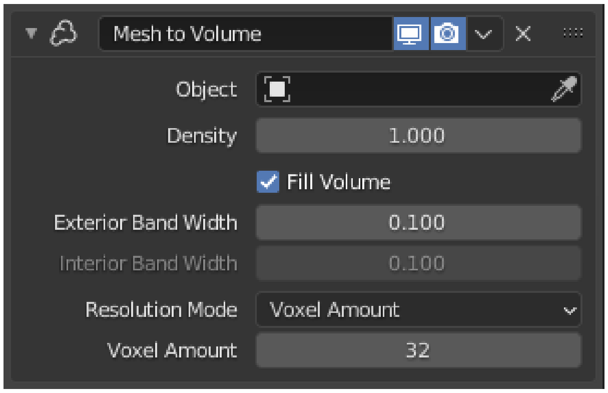
This modifier is only available for Volume Objects.

The *Mesh to Volume* modifier uses a mesh to create a new volume grid. All previously existing volume grids on the volume object are discarded. So this modifier is usually added to an empty volume object. The new volume grid is called “density”.

Tip

To copy and move the generated volume separately from the mesh object, use a collection instance.

Options



Mesh to Volume

Object

Density 1.000

☑ Fill Volume

Exterior Band Width 0.100

Interior Band Width 0.100

Resolution Mode Voxel Amount

Voxel Amount 32

The Mesh to Volume modifier.

Object
: The mesh object that determines where the volume data will be generated.

Density
: Makes the generated volume appear denser or less dense when rendering.

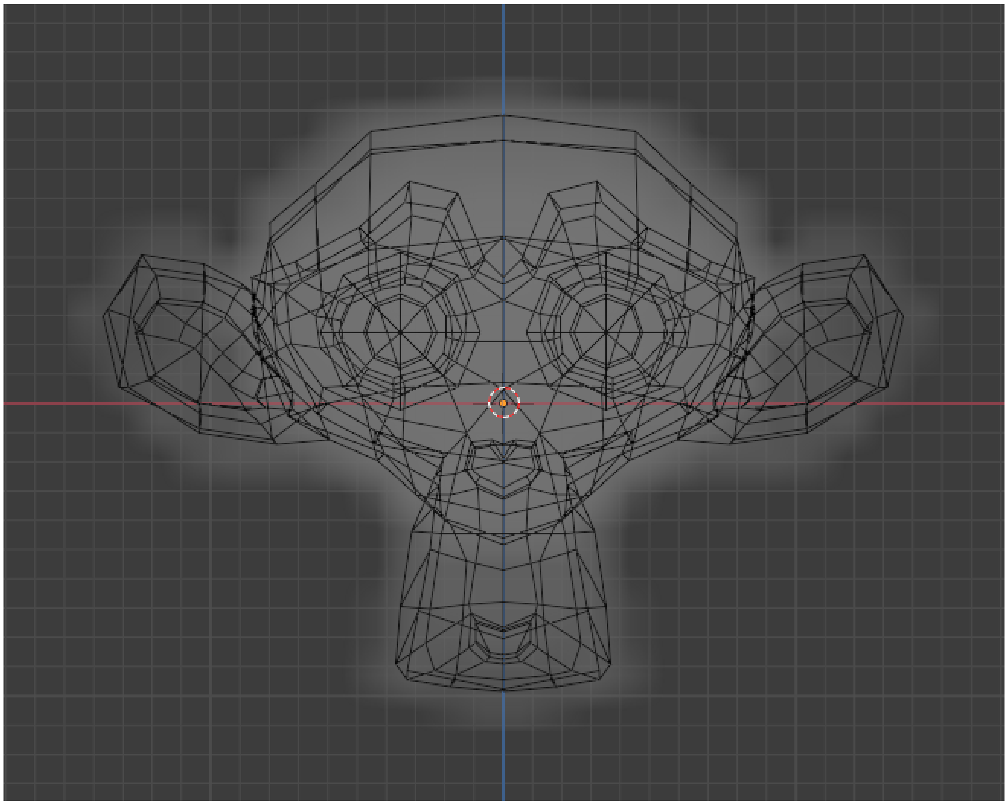
Interior Band Width
: The maximum distance of the included voxels to the surface on the inside of the mesh.

Resolution Mode

Mode for how the voxel size is specified.

Voxel Amount::	This allows setting an approximate number of voxels that will be used to represent mesh along its diagonal. When the dimensions of the mesh changes, the voxel size will change as well. For final rendering of animations, it's better to specify the voxel size explicitly to avoid artifacts.
Voxel Size::	This allows setting the exact voxel size that will be used. This is idea for rendering when the voxel size should not change between frames.

Example

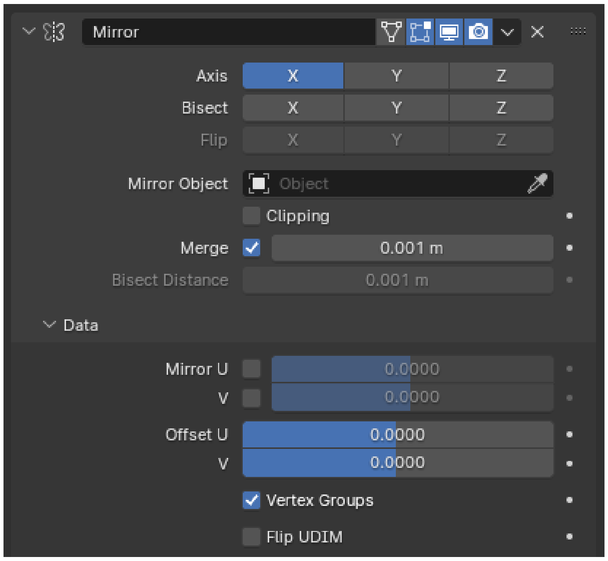


Converting Suzanne to a volume.

Mirror Modifier

The *Mirror* modifier mirrors a mesh along its local X, Y and/or Z axes, across the [Object Origin](). It can also use another object as the mirror center, then use that object's local axes instead of its own.

Options



Mirror

Axis: X Y Z

Bisect: X Y Z

Flip: X Y Z

Mirror Object: Object

☐ Clipping

Merge ☑ 0.001 m

Bisect Distance 0.001 m

Data

Mirror U ☐ 0.0000

V ☐ 0.0000

Offset U 0.0000

V 0.0000

☑ Vertex Groups

☐ Flip UDIM

The Mirror modifier.

Axis

The X, Y, Z axis along which to mirror, i.e. the axis perpendicular to the mirror plane of symmetry.

To understand how the axis applies to the mirror direction, if you were to mirror on the X axis, the positive X values of the original mesh would become the negative X values on the mirrored side.

You can select more than one of these axes. And will then get more mirrored copies. With one axis you get a single mirror, with two axes four mirrors, and with all three axes eight mirrors.

Bisect

If the mesh is already on both sides of the mirror plane, it is cut by that plane, and only one side (the "positive" one by default) is kept to perform the mirror process.

Flip

When *Bisect* is enabled on an axis, you can use this setting to switch the side kept and mirrored (i.e. when it is enabled, the “negative” side will be kept, instead of the “positive” one).

Mirror Object

An Object Selector to select an object (usually an empty), which position and rotation will be used to define mirror planes (instead of using the ones from the modified object).

You can animate it to move the mirror axis.

Clipping

Prevents vertices from moving through the mirror plane(s) when you transform them in Edit Mode.

If it is enabled but vertices are beyond the mirror plane and outside of the *Merge Distance*, the vertices will not be merged. But as soon as the vertices are within *Merge Distance* they are snapped together and cannot be moved beyond the mirror plane.

Note

Vertices on the mirror plane will be unable to move away from the mirror plane as long as *Clipping* is enabled. You must disable it to be able to move the vertices along the mirror axis again.

Merge

Where a vertex is in the same place (within the *Merge Distance*) as its mirror it will be merged with the mirrored vertex.

Merge Distance

The maximum distance between a vertex and its mirror copy at which they are merged together (being snapped on the mirror plane). Needs *Merge* to be enabled.

Bisect Distance

Distance from the bisect plane within which vertices are removed.

Data

Flip UV

With this option you can mirror the UV texture coordinates across the middle of the image.

E.g. if you have a vertex with UV coordinates of (0.3, 0.9), its mirror copy will have UV coordinates of (0.7, 0.1).

UV Offsets

Amount to shift mirrored UVs on the U/V axes.

It’s useful for baking (as overlapping UVs can cause artifacts to appear in the baked map), so the UVs can be moved outside the image and not used for baking, but still be used for display.

Vertex Groups

Try to mirror existing vertex groups, with the following specific prerequisites:

- The vertex groups you want to mirror must be named following the usual left/right pattern (i.e. with suffixes like “.R”, “.right”, “.L”, etc.).
- The mirror side vertex group must already exist (it will not be created automatically). It must also be completely empty (no vertices assigned to it).

Flip UDIM

Mirror the texture coordinates around each tile center.

Hints

Many modeling tasks involve creating objects that are symmetrical. This modifier offers a simple and efficient way to do this, with real-time update of the mirror as you edit it. Once your modeling is completed you can either click *Apply* to make a real version of your mesh, or leave it as-is for future editing.

Accurately Positioning the Mirror Plane

To apply a *Mirror* modifier, it is common to have to move the object's origin onto the edge or face that is to be the axis for mirroring. This can be tricky when attempted visually.

A good technique to achieve an exact position is to select the edge, then snap *Cursor to Selection*. This will position the 3D Cursor in the center of the edge. Finally, use the Set Origin menu, and select *Origin to 3D Cursor*. This will move the object's origin (and thus, the mirror plane) to where the 3D cursor is located, and the mirroring will be exact.

An alternative is to use an empty as a *Mirror Object* that you move to the correct position.

Multiresolution Modifier

The *Multiresolution* modifier (often shortened to “Multires”) gives you the ability to subdivide a mesh similarly to the Subdivision Surface modifier, but also allows you to edit the new subdivision levels in Sculpt Mode.

Note

Multiresolution is the only modifier that cannot be repositioned in the stack after any modifier that will change geometry or other object data (i.e. all *Generate*, some *Modify* and some *Simulate* modifiers cannot come before the *Multiresolution*).

Deform modifiers will be applied onto the Multires subdivision levels instead of the base mesh, if they come after the Multires.

Tip

This is especially useful for re-projecting details from another sculpt with a Shrinkwrap modifier. For the best result make sure to set the wrap method to *Project*, snap mode to *Above Surface* and enable *Negative*.

Options

Levels Viewport
    Set the level of subdivisions to show in the viewport.

Sculpt
    Set the level of subdivisions to use specifically in Sculpt Mode. While in Sculpt mode use `Alt-1` to decrease the level or `Alt-2` to increase.

Render

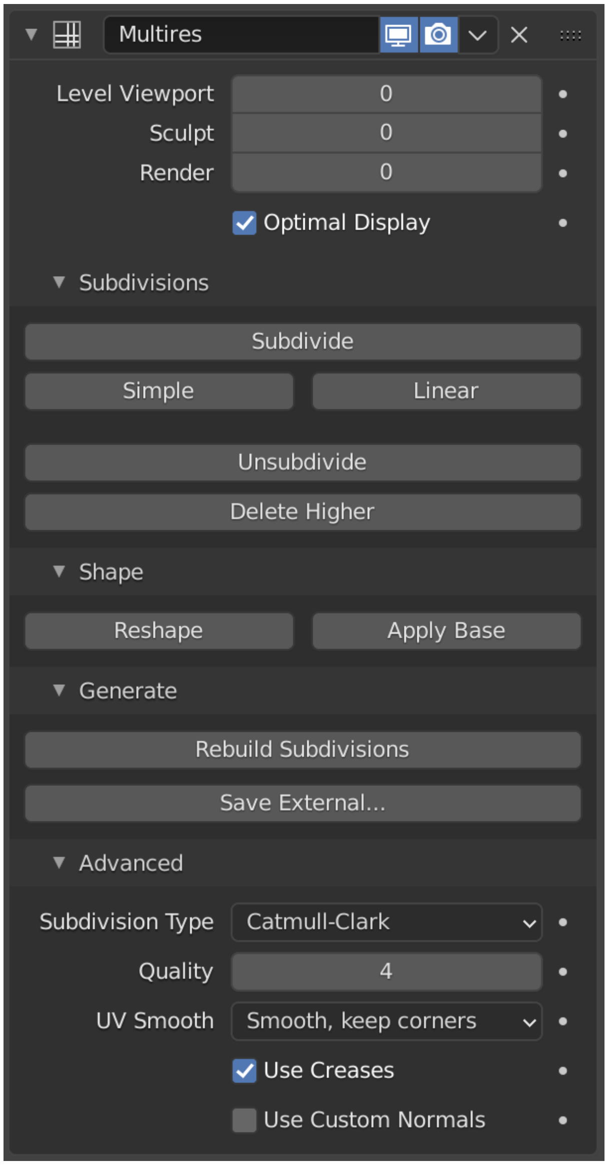
Set the level of subdivisions to show when rendering.

Sculpt Base Mesh

Deform the unsubdivided base mesh instead of the higher levels. Meanwhile the set level will be previewed. This allows you to make much broader changes in visual context to higher sculpted details without creating surface noise and artifacts.

Optimal Display

Only display the edges of the original geometry. So when rendering the wireframe of this object, the wires of the subdivided edges will be skipped.


Multires
Subdivisions
Subdivide
Simple
Linear
Unsubdivide
Delete Higher
Shape
Reshape
Apply Base
Generate
Rebuild Subdivisions
Save External...
Advanced

Level Viewport 0

Sculpt 0

Render 0

☑ Optimal Display

Subdivision Type Catmull-Clark

Quality 4

UV Smooth Smooth, keep corners

☑ Use Creases

☐ Use Custom Normals

The Multiresolution modifier.

Subdivisions

Subdivide

Creates a smooth level of subdivision (using the default Catmull-Clark algorithm).

Simple

Creates a level of subdivision with un-smoothed base mesh edges (using a simple interpolation by subdividing edges without any smoothing).

Linear

Creates a completely un-smoothed level of subdivision (using linear interpolation of the current sculpted displacement).

Unsubdivide

Rebuild a lower subdivision level of the current base mesh.

Delete Higher

Deletes all subdivision levels that are higher than the current one.

Shape

Reshape

Copy the shape of another object onto the multires levels by copying its vertex coordinates.

To use it, first select a different mesh object with matching topology and vertex indices, then `Shift` select the object you wish to copy vertex coordinates to, and click *Reshape*.

Apply Base

Modifies the original unsubdivided mesh to match the form of the subdivided mesh.

Generate

Rebuild Subdivisions

Rebuilds all possible subdivisions levels to generate a lower resolution base mesh. This is used to create an optimized multiresolution version of a preexisting sculpt. This option is only available when no subdivision level have been created through the modifier.

Save External

Saves displacements to an external `.btx` file.

Advanced

Quality

How precisely the vertices are positioned (relatively to their theoretical position), can be lowered to get a better performance when working on high-poly meshes.

UV Smooth

How to handle UVs during subdivision.

None::	UVs remain unchanged.
Keep Corners::	UV islands are smoothed, but their boundary remain unchanged.
Keep Corners, Junctions::	UVs are smoothed, corners on discontinuous boundary and junctions of three or more regions are kept sharp.
Keep Corners, Junctions, Concave::	UVs are smoothed, corners on discontinuous boundary, junctions of three or more regions and darts and concave corners are kept sharp.
Keep Boundaries::	UVs are smoothed, boundaries are kept sharp.
All::	UVs and their boundaries are smoothed.

Boundary Smooth

Controls how open boundaries (and corners) are smoothed.

All::	Smooth boundaries, including corners.
Keep Corners::	Smooth boundaries, but corners are kept sharp.

Use Creases

Use the Weighted Edge Creases values stored in edges to control how smooth they are made.

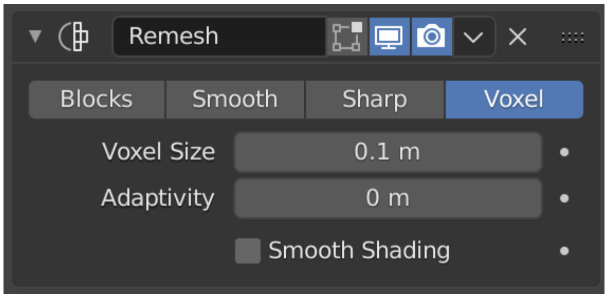
Use Custom Normals

Interpolates existing Custom Split Normals of the resulting mesh.

Remesh Modifier

The *Remesh* modifier is a tool for generating new mesh topology. The output follows the surface curvature of the input, but its topology contains only quads.

Options



Voxel Size: 0.1 m

Adaptivity: 0 m

☐ Smooth Shading

The Remesh modifier.

Mode

There are three basic modes available in the *Remesh* modifier. The output topology is almost identical between the three modes, what changes is the smoothing.

Blocks

There is no smoothing at all.

Smooth

Output a smooth surface.

Sharp

Similar to *Smooth*, but preserves sharp edges and corners.

Sharpness

Higher values produce edges more similar to the input, while lower values filter out noise.

Voxel

Uses an OpenVDB to generate a new manifold mesh from the current geometry while trying to preserve the mesh's original volume.

Adaptivity

Reduces the final face count by simplifying geometry where detail is not needed. This introduce triangulation to faces that do not need as much detail.

Smooth Shading

Outputs faces with Smooth Shading instead of flat shading.

Octree Depth

Sets the resolution of the output. Low values will generate larger faces relative to the input, higher values will generate a denser output.

Scale

The result can be tweaked further by this, lower values effectively decrease the output resolution.

Remove Disconnected

Filter out small disconnected pieces of the output.

Thin parts of the input mesh can become loose, and generate small isolated bits of mesh. This option will remove those.

Threshold

Use this to control how small a disconnected component must be to be removed.

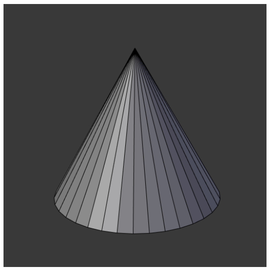
Smooth Shading

Output faces with smooth shading rather than flat shading. The smooth/flat shading of the input faces is not preserved.

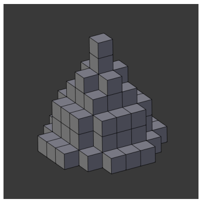
Note

The input mesh should have some thickness to it. If the input is completely flat, add a Solidify Modifier above the *Remesh* one.

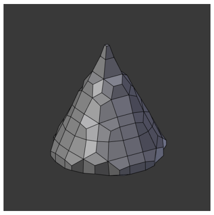
Examples



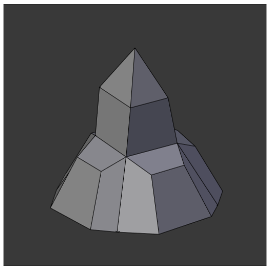
Unmodified mesh.



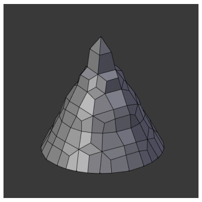
Blocks mode with Octree Depth 3.



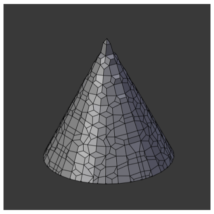
Smooth mode with Octree Depth 3.



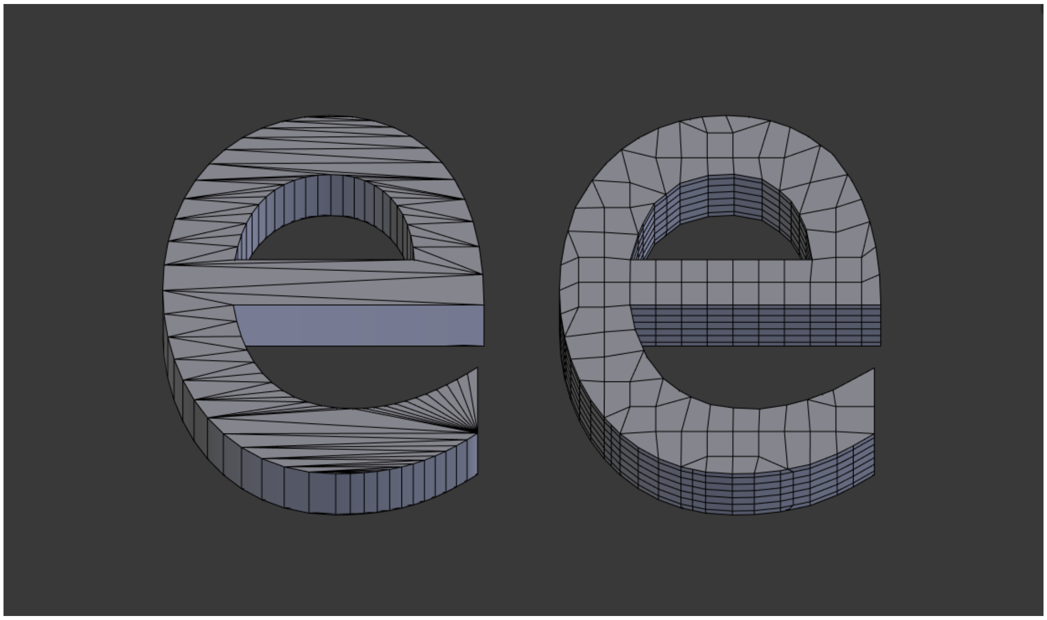
Sharp mode with Octree Depth 2.



Sharp mode with Octree Depth 3.



Sharp mode with Octree Depth 4.

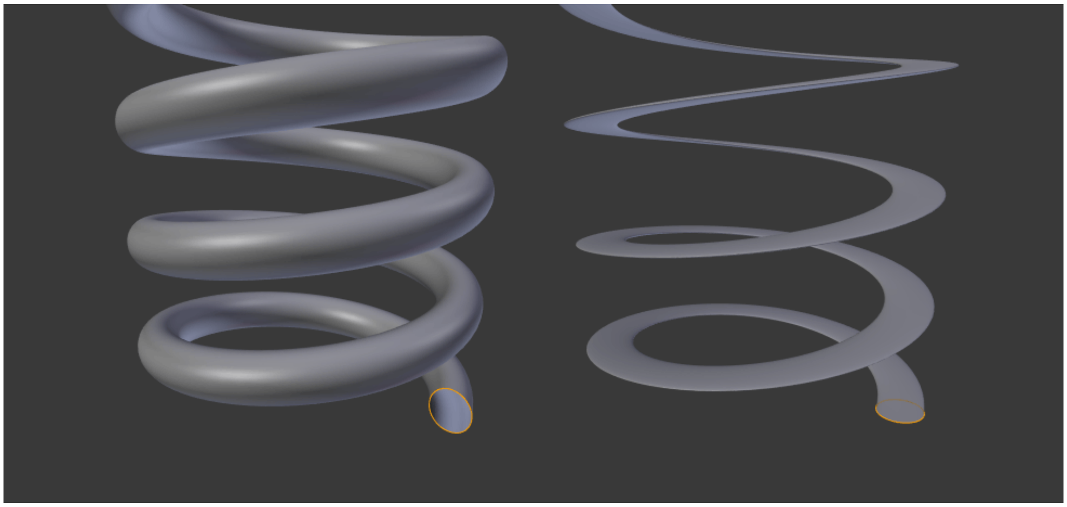


The Remesh Modifier applied to a text to improve its topology.

Animated Example

Screw Modifier

The *Screw* modifier is similar to the Screw tool in the Toolbar, in that it takes a profile object, a mesh or a curve, to create a helix-like shape.



Properly aligning the profile object is important.

The profile should be properly aligned to the cardinal direction of the object rather than to the screw axis.

Options

Angle
: Degrees for a single helix revolution.

Screw
: The height of one helix iteration.

Iterations
: Number of revolutions.

Axis

The axis along which the helix will be built.

Axis Object

The name of an object to define the axis direction.

Object Screw

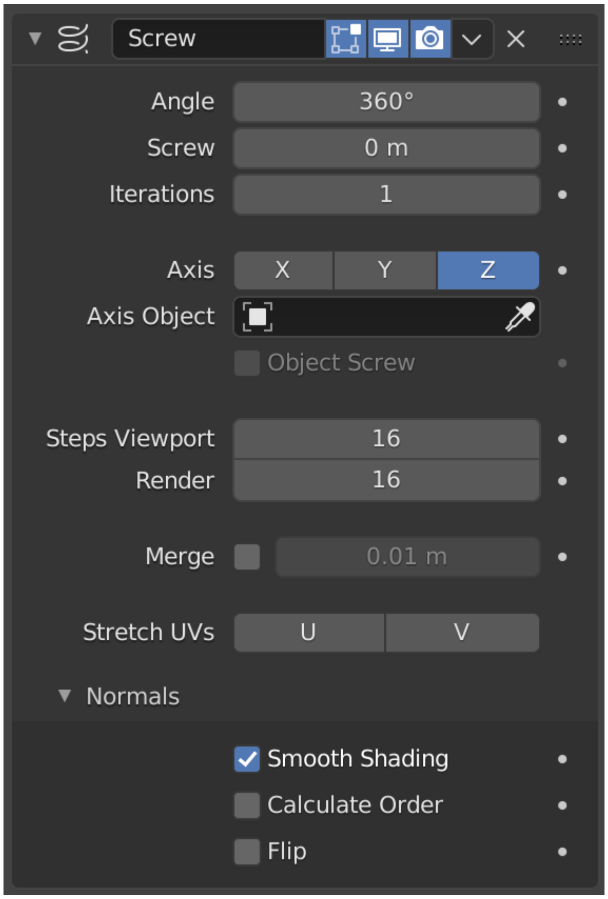
Use the distance from the *Axis Object* to define the height of one helix iteration.

Steps Viewport

Number of steps used for a single revolution displayed in the 3D Viewport.

Render

As above, but used during render time. Increase to improve quality.



Screw

Angle 360°

Screw 0 m

Iterations 1

Axis X Y Z

Axis Object

☐ Object Screw

Steps Viewport 16

Render 16

Merge ☐ 0.01 m

Stretch UVs U V

▼ Normals

☑ Smooth Shading

☐ Calculate Order

☐ Flip

The Screw modifier.

Merge

Merge vertices that lie on the axis of rotation. Use this to close off end points with a triangle fan.

Merge Distance

Vertices under this distance to the axis are merged.

Stretch UVs

Stretch the UV coordinates from (0.0 to 1.0) when UVs are present.

Normals

Smooth Shading

Output faces with smooth shading rather than flat shading. The smooth/flat shading of the input geometry is not preserved.

Calculate Order

Order of edges is calculated to avoid problems with normals and shading. Only needed for meshes, not curves.

Flip

Flip normals direction.

Skin Modifier

The *Skin* modifier uses vertices and edges to create a skinned surface, using a per-vertex radius to better define the shape. The output is mostly quads, although some triangles will appear around intersections.

It is a quick way to generate base meshes for sculpting and/or smooth organic shapes with arbitrary topology.

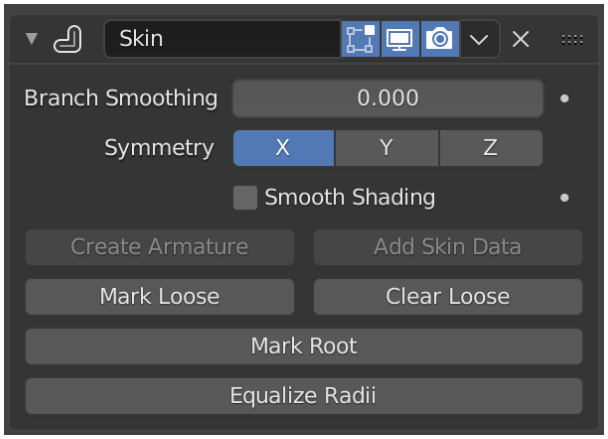
Note

Faces in the original geometry are ignored.

Options

Branch Smoothing

A branch point is a vertex with three or more connected edges. These areas tend to produce more complicated topology, some of which may overlap. This setting relaxes the surface around these points, with the side effect of shrinking it.



Skin

Branch Smoothing 0.000

Symmetry X Y Z

☐ Smooth Shading

The Skin modifier.

Symmetry

These checkboxes are used to keep the output topology symmetrical in their respective axes. In other words, using it avoids merging triangles across an axis unless the triangles form a symmetric quad.

Note

They do not add geometry flipped across an axis. For that, the Mirror modifier should be used, typically placed above the Skin one.

Smooth Shading

Output faces with smooth shading rather than flat shading. The smooth/flat shading of the input geometry is not preserved.

Create Armature

Create an armature on top of the object. Each edge becomes a bone.

Note

If the root vertex has more than one adjacent edge, an extra bone will be created to serve as the root.

This tool does the following:

1. A new armature object is added with bones matching the input mesh. The active selection is switched to the new armature.
2. Weight groups are added to the input mesh. The Skin modifier propagates these weights to the output as well.
3. An Armature modifier is added directly below the Skin one. Note that the Armature modifier is being applied after the Skin one because it should only deform the output, whereas if it were above, it might change the resulting topology.

Add Skin Data

This modifier uses a custom set of data in the mesh, that is generated automatically when you add the modifier the first time.

However, you may remove that data, or loose it some way or the other. That operator will generate it again.

Mark/Clear Loose

By default, a branch vertex (vertex with three or more connected edges) will generate extra edge loops along adjacent edges in order to keep the output tight. Branches can be made loose by clicking *Mark Loose*, which will allow the output to stretch between all adjacent vertices. This can be disabled again by clicking *Clear Loose*.

Mark Root

Marking a vertex as root causes that vertex to be used for calculating rotations for connected limbs. Root vertices also affect the armature output, they will be used as the origin for the root bones.

Each set of connected vertices should have one root node (one is selected by default if you do not assign any manually). *Mark Root* enforces the one-root per set rule, so it is not necessary to manually unmark roots.

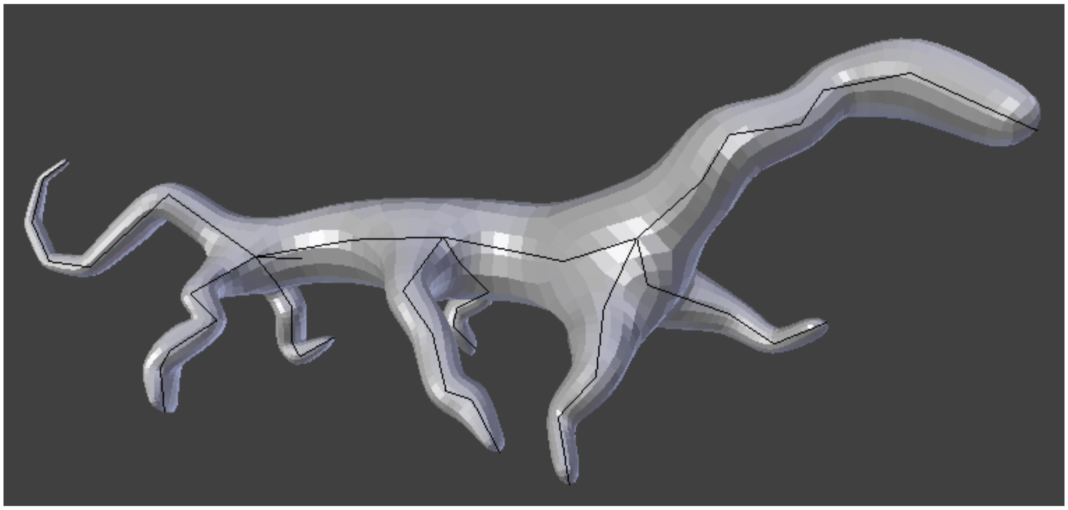
Equalize Radii

Makes the skin radii of selected vertices equal on each axis.

Skin Mesh Data

That modifier needs a set of specific data in the original mesh to work properly. This data allows you to define the root vertices of each tree, which ones are loose, and the size (radius) of the skin at each vertex. The radii of input vertices can be individually scaled in Edit Mode with the Skin Resize.

Examples



Simple creature, made with only the Skin and Subdivision Surface modifiers.

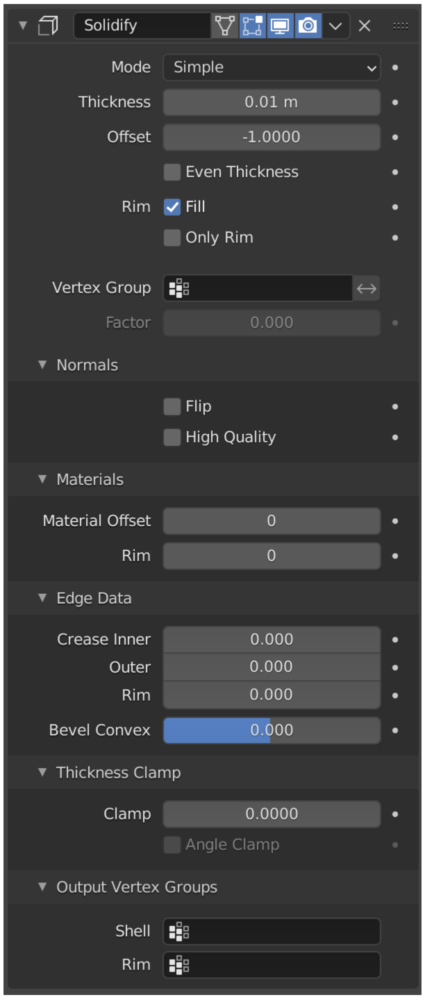
External Links

- Skin Modifier Development at Blender Nation – An early demonstration of the Skin Modifier by Nicholas Bishop (March 2011).
- Ji, Zhongping; Liu, Ligang; Wang, Yigang (2010). B-Mesh: A Fast Modeling System for Base Meshes of 3D Articulated Shapes, Computer Graphics Forum 29(7), pp. 2169-2178. – The work this modifier is based on (DOI 10.1111/j.1467-8659.2010.01805.x).
- Related thread on Blender artists.

Solidify Modifier

The *Solidify* modifier takes the surface of any mesh and adds depth, thickness to it.

Options



Solidify

Mode: Simple

Thickness: 0.01 m

Offset: -1.0000

☐ Even Thickness

Rim: ☑ Fill

☐ Only Rim

Vertex Group:

Factor: 0.000

▾ Normals

☐ Flip

☐ High Quality

▾ Materials

Material Offset: 0

Rim: 0

▾ Edge Data

Crease Inner: 0.000

Outer: 0.000

Rim: 0.000

Bevel Convex: 0.000

▾ Thickness Clamp

Clamp: 0.0000

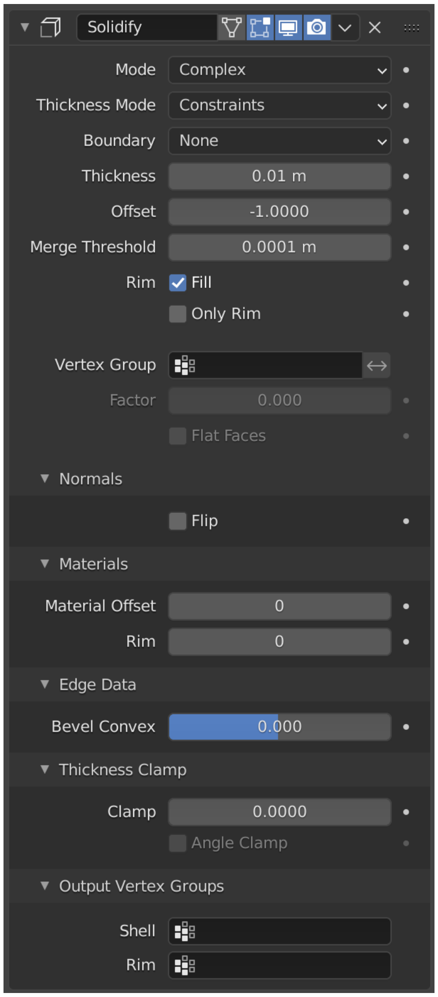
☐ Angle Clamp

▾ Output Vertex Groups

Shell:

Rim:

The Solidify modifier in simple mode.



Solidify

Mode: Complex

Thickness Mode: Constraints

Boundary: None

Thickness: 0.01 m

Offset: -1.0000

Merge Threshold: 0.0001 m

Rim: ☑ Fill

☐ Only Rim

Vertex Group:

Factor: 0.000

☐ Flat Faces

▾ Normals

☐ Flip

▾ Materials

Material Offset: 0

Rim: 0

▾ Edge Data

Bevel Convex: 0.000

▾ Thickness Clamp

Clamp: 0.0000

☐ Angle Clamp

▾ Output Vertex Groups

Shell:

Rim:

The Solidify modifier in complex mode.

Mode

Simple

This is the default solidify algorithm, which simply extrudes the geometry. This algorithm does not work on geometry where edges have more than two adjacent faces.

Important

If the normals of adjacent faces don't point into the same general direction, simple mode will not be able to solidify the boundary between those. This happens if the normals are not recalculated or for example on one-sided surfaces like a Möbius strip.

Complex

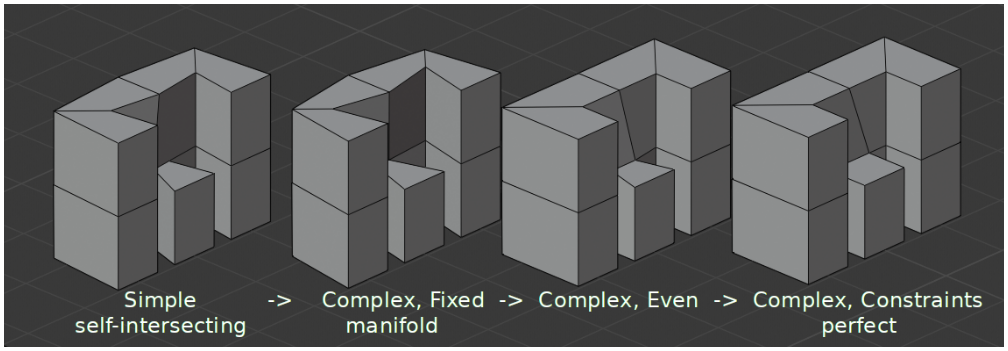
This is a solidify algorithm which can handle every geometric situation to guarantee a manifold output geometry. This algorithm is able to solidify shapes like Möbius strips, Klein bottles, architectural wall layouts and many more which the *Simple Mode* isn't able to do. If the special cases are not present it is recommended to choose *Simple* because the extra logic makes this algorithm much slower.

Note

There are no options for crease in the Modifier tab because crease is handled in a dynamic way. The modifier will transfer the creases of the original mesh in a smart way to the output mesh to work with the Subdivision Surface modifier.

Thickness Mode *Complex Mode*

Choose the kind of thickness handling (thickness solver).


Simple
self-intersecting
->
Complex, Fixed
manifold
->
Complex, Even
->
Complex, Constraints
perfect

Different thickness options on a non-manifold mesh.

Fixed

This is similar to *Simple Mode* without *Even Thickness*. The new vertices are always in a fixed distance to the old ones.

Even

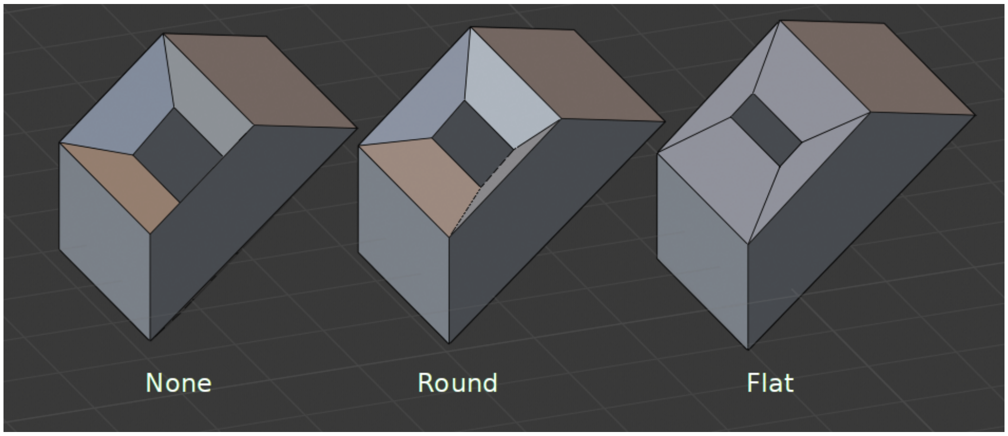
This is similar to *Simple Mode* with *Even Thickness* and *High Quality Normals*. It adjusts for sharp corners, but may not always work when more than three faces come together.

Constraints

This is a more advanced model to try to always get the optimal thickness everywhere. For up to three faces it is always guaranteed to find an optimal solution.

Boundary *Complex Mode*

Choose the kind of boundary that suits the model the most.


None
Round
Flat

Different boundary options with a matCap.

None

No boundary fix is applied. Results are stable.

Round

Adjusts the boundary for an opening to face inwards (like a hole in an egg).

Flat

Adjusts the boundary of a planar opening to be a flat (like a cut sphere).

Thickness

The depth to be solidified.

Important

The modifier thickness is calculated using local vertex coordinates. If the object has a non-uniform scale, the thickness will vary on different sides of the object.

To fix this, either Apply or Clear the scale.

Offset

A value between (-1 to 1) to locate the solidified output inside or outside the original mesh. The inside and outside is determined by the face normals. Set to 0.0, the solidified output will be centered on the original mesh.

Even Thickness *Simple Mode*

Maintain thickness by adjusting for sharp corners. Sometimes improves quality but also increases computation time.

Merge Threshold *Complex Mode*

Distance within which degenerated geometry is merged.

Rim

Fill

Fills the gap between the inner and outer edges.

Only Rim

In *Simple Mode*: Will not extrude surfaces parallel to the original one, but instead will only add the perpendicular rim.

In *Complex Mode*: Will only leave the generated perpendicular rim.

Note

Fill and *Only Rim* only make a difference on Non-manifold objects, since the rims are generated from the borders of the original geometry.

Vertex Group

The weights of the selected vertex group are multiplied onto the *Thickness*, so vertices with lower weights will be less thick. The vertices which are not part of the vertex group will be used as if their weight was zero.

Invert

Reverses the vertex group weights, so that the used weight is one minus the actual weight.

Factor

How much the vertex weights are taken into account.

- On 0.0 , vertices with zero weight will have no thickness at all.
- On 0.5 , vertices with zero weight will be half as thick as those with full weight.
- On 1.0 , the weights are ignored and the *Thickness* value is used for every vertex.

Flat Faces *Complex Mode*

Use the minimal vertex weight assigned to the vertices of a face to make sure that new faces stay parallel to their original ones. This is slow, so disable it when it is not needed.

Note

If the final thickness of a vertex is zero, it will still be solidified. Therefore creating duplicate geometry, which sometimes needs extra care.

Normals

Flip Normals
Reverse the normals of all geometry (both the inner and outer surfaces).

High Quality Normals *Simple Mode*
Normals are calculated to produce a more even thickness. Sometimes improves quality but also increases computation time.

Materials

Material Offset
Choose a different material slot index to use for the new geometry. This is applied as an offset from the original material of the face from which it was solidified.

- A value of 0 means it will use the same material.
- A value of 1 means it will use the material immediately below the original material.
- A value of -2 means the material two positions above the original material will be used.

These are clamped to the top-most and bottom-most material slots.

Rim
Similarly, you can give another material to the rim faces.

Edge Data

Inner *Simple Mode*
Set a crease to the inner edges.

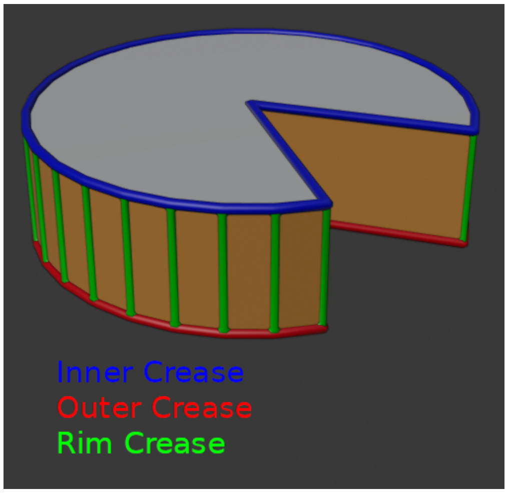
Outer *Simple Mode*
Set a crease to the outer edges.

Rim *Simple Mode*

Set a crease to the rim.

Bevel Convex

Edge bevel weight to be added to outside edges.

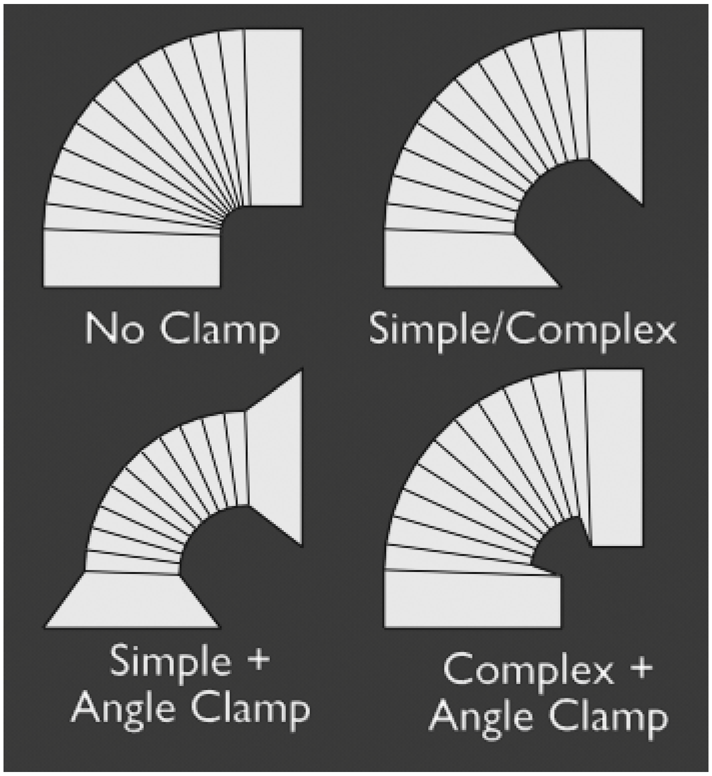

Inner Crease
Outer Crease
Rim Crease

Edges which will get creases marked.

Thickness Clamp

Clamp

A value between (0 to 2) to clamp offsets to avoid self-intersection. The amount is determined by the length of the shortest adjacent edge.


No Clamp
Simple/Complex
Simple + Angle Clamp
Complex + Angle Clamp

Clamp Offset.

Angle Clamp
: If enabled clamping will also consider angles in the geometry, not only lengths.

Output Vertex Groups

Shell
: Vertex group that the generated shell geometry will be weighted to. This allows you to use other modifiers to only affect the shell geometry by using a that modifier's vertex group influence control.

Rim
: Same as *Shell Vertex Group*, but for the generated rim geometry.

Known Limitations

Even Thickness

Solidify thickness is an approximation. While *Even Thickness* and *High Quality Normals* should yield good results, the final wall thickness is not guaranteed and may vary depending on the mesh topology. Especially for vertices with more than three adjacent faces.

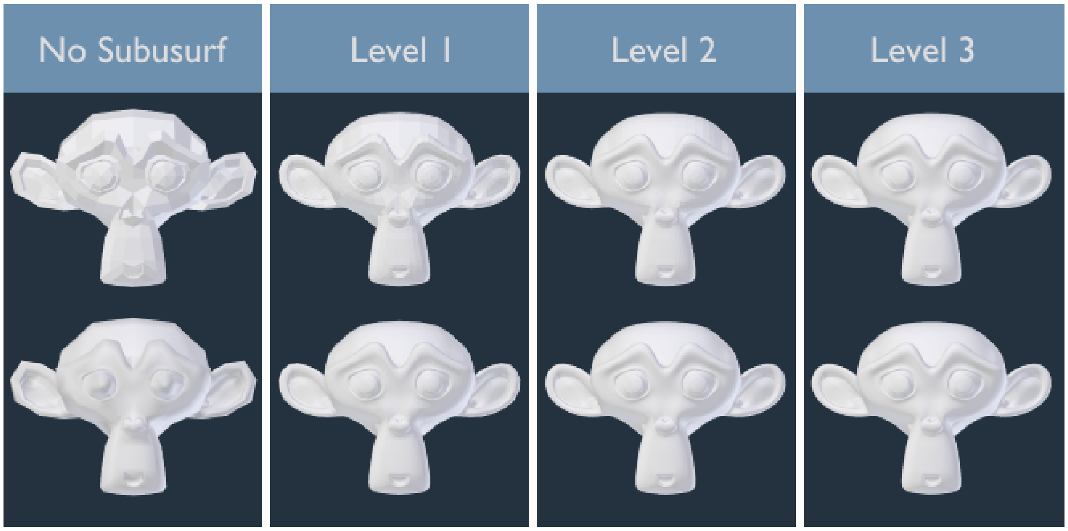
In order to maintain a precise wall thickness in every case, we would need to add/remove faces on the offset shell, something this modifier does not do since this would add a lot of complexity. The best option to preserve wall thickness is complex mode with constraints thickness mode, but it is also not guaranteed to work perfect in every case.

Subdivision Surface Modifier

The *Subdivision Surface* modifier (often shorten to “Subdiv”) is used to split the faces of a mesh into smaller faces, giving it a smooth appearance. It enables you to create complex smooth surfaces while modeling simple, low-vertex meshes. It avoids the need to save and maintain huge amounts of data, and gives a smooth “organic” look to the object.

As with any modifier, order of execution (position in the modifier stack) has an important bearing on the results.

Keep in mind that this is a different operation than its companion, Smooth Shading. You can see the difference between the two in the grid image below.



Subdivision levels 0 to 3, without and with Smooth Shading.

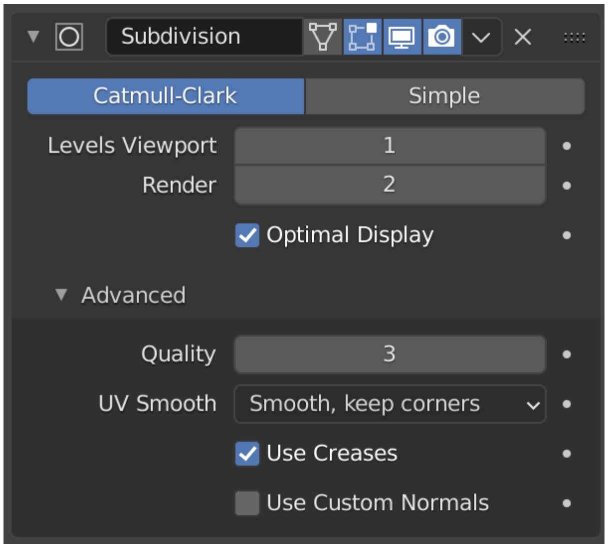
Tip

The *Subdivision Surface* modifier does not allow you to edit the new subdivided geometry without applying it, but the Multiresolution modifier does (in Sculpt Mode).

Note

This modifier uses the OpenSubdiv library as a backend.

Options


Subdivision

Catmull-Clark | Simple

Levels Viewport 1

Render 2

☑ Optimal Display

Advanced

Quality 3

UV Smooth: Smooth, keep corners

☑ Use Creases

☐ Use Custom Normals

The Subdivision Surface modifier.

Catmull-Clark

Subdivides and smooths the surfaces to create a more pleasant looking mesh. According to its Wikipedia page, the “arbitrary-looking formula was chosen by Catmull and Clark based on the aesthetic appearance of the resulting surfaces rather than on a mathematical derivation.”

Simple

Only subdivides the surfaces, this often does not provide any smoothing unless the surface is non-coplanar (the same as the Subdivide operator, in Edit Mode). To work around this behavior for non-coplanar geometry, triangulate to ensure all geometry is coplanar.

Simple mode can be used, for example, to increase the base mesh resolution when using displacement maps.

Levels Viewport, Render

The number of subdivision levels shown in the 3D Viewport or the final render.

Warning

Higher levels of subdivisions results in more vertices, which means higher memory consumption (both system RAM, and video memory for display). This can cause Blender to hang or crash if not enough memory is available.

Tip

The right combination of these settings will allow you to keep a fast and lightweight approximation of your model when interacting with it in the 3D Viewport, but use a higher quality version when rendering.

Be careful not to set the *Viewport* subdivisions higher than the *Render* subdivisions, this would mean that the quality in the 3D Viewport will be higher than the rendered.

Optimal Display

When rendering the wireframe of this object, the wires of the new subdivided edges will be skipped (only displays the edges of the original geometry).

Advanced

Use Limit Surface

Places vertices at the surface that would be produced with infinite levels of subdivision (smoothest possible shape).

Quality

When *Use Limit Surface* is enabled this property controls how precisely vertices are positioned on the limit surface (relatively to their theoretical position of an infinitely subdivided mesh). It can be lowered to get a better performance.

Using higher values does not necessarily mean real improvement in quality, ideal results might be reached well before the maximum *Quality* value.

Note

This value can affect the accuracy of Edge Creases; using a higher *Quality* value will allow for a wider range of crease values to work accurately.

UV Smooth

Controls how subdivision smoothing is applied to UVs.

None::	UVs remain unchanged.
Keep Corners::	UV islands are smoothed, but their boundary remain unchanged.
Keep Corners, Junctions::	UVs are smoothed, corners on discontinuous boundary and junctions of three or more regions are kept sharp.
Keep Corners, Junctions, Concave::	UVs are smoothed, corners on discontinuous boundary, junctions of three or more regions and darts and concave corners are kept sharp.
Keep Boundaries::	UVs are smoothed, boundaries are kept sharp.
All::	UVs and their boundaries are smoothed.

Boundary Smooth

Controls how open boundaries (and corners) are smoothed.

All::	Smooth boundaries, including corners.
Keep Corners::	Smooth boundaries, but corners are kept sharp.

Use Creases

Use the Weighted Edge Creases values stored in edges to control how smooth they are made.

Use Custom Normals

Interpolates existing Custom Split Normals of the resulting mesh. Otherwise, new faces will have the overall normal orientation of that original face.

Keyboard Shortcuts

To quickly add a *Subdivision Surface* modifier to one or more objects, select the object(s) and press `Ctrl-1`. That will add a Subdivision Surface modifier with *Viewport* subdivisions set to 1. You can use other numbers too, such as `Ctrl-2`, `Ctrl-3`, etc, to add a modifier with that number of subdivisions. Adding a *Subdivision Surface* modifier in this fashion will not modify the *Render* subdivisions.

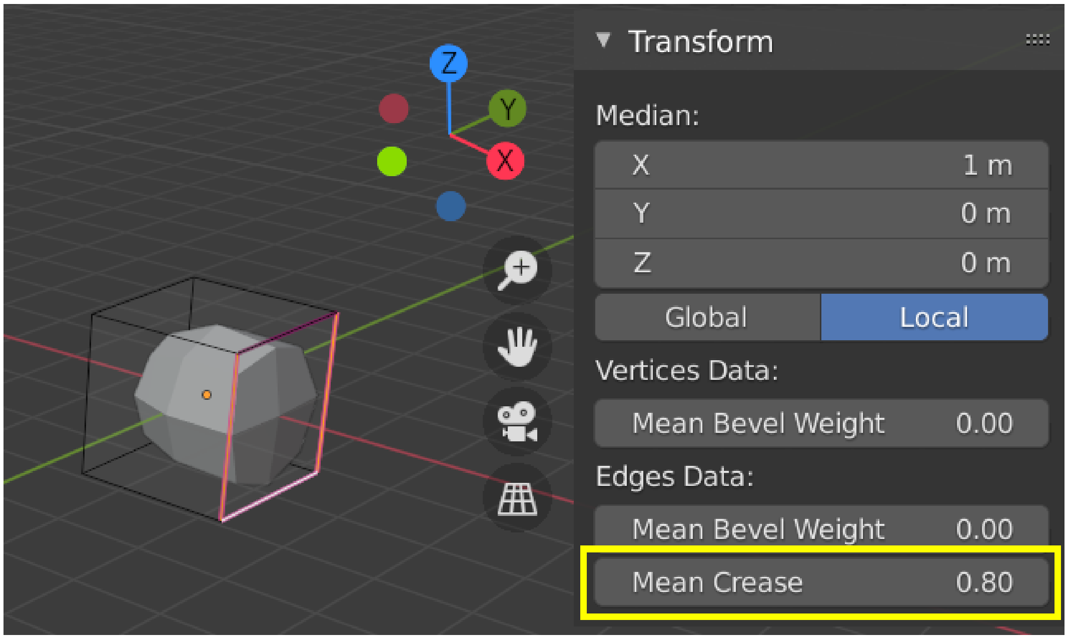
If an object already has a *Subdivision Surface* modifier, doing this will simply change its subdivision level instead of adding another modifier.

Control

Catmull-Clark subdivision rounds off edges, and often this is not what you want. There are several solutions that allow you to control the subdivision.

Weighted Edge Creases

Weighted edge creases for subdivision surfaces allows you to change the way the *Subdivision Surface* modifier subdivides the geometry to give the edges a smooth or sharp appearance.



Transform

Median:

X 1 m

Y 0 m

Z 0 m

Global Local

Vertices Data:

Mean Bevel Weight 0.00

Edges Data:

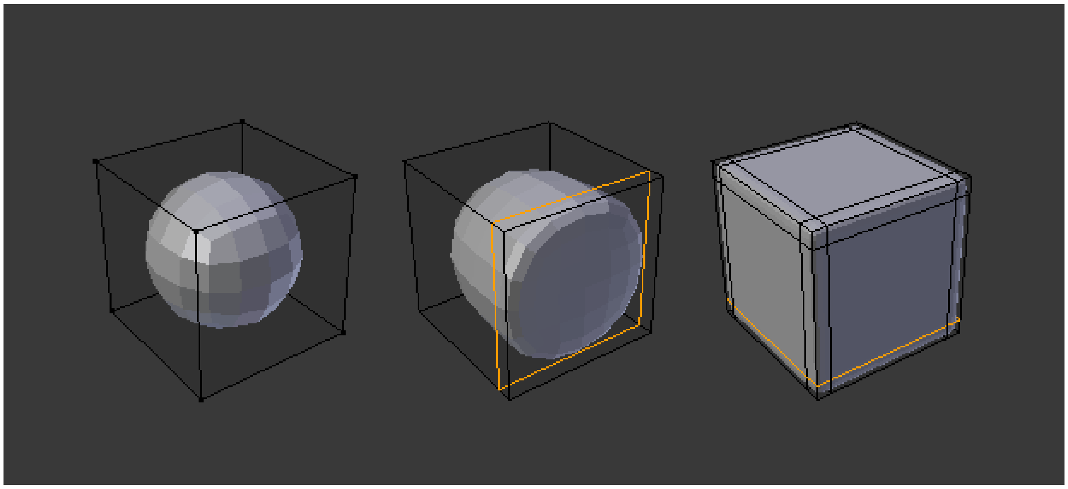
Mean Bevel Weight 0.00

Mean Crease 0.80

A subdivided cube with creased edges.

The crease weight of selected edges can be changed in the *Transform* panel, Sidebar of the 3D Viewport. The scale-like dedicated tool `Shift-E` can also be used to adjust the crease weight. A higher value makes the edge “stronger” and more resistant to the smoothing effect of subdivision surfaces.

Edge Loops



Subdivision Level 2 cube, the same with an extra Edge Loop, and the same with six extra Edge Loops.

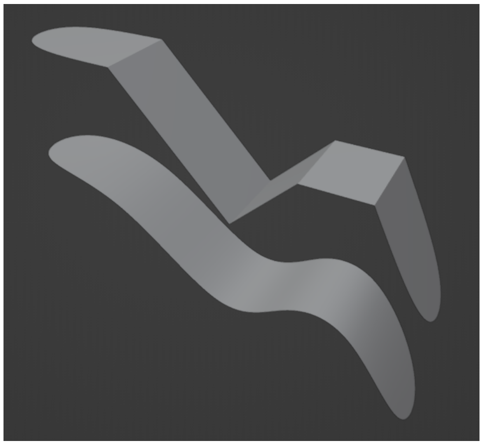
The *Subdivision Surface* modifier demonstrates why good, clean topology is so important. As you can see in the figure, it has a drastic effect on a default cube. Until you add in additional loops (with e.g. Loop Cut and Slide), the shape is almost unrecognizable as a cube.

A mesh with deliberate topology has good placement of edge loops, which allow the placement of more loops (or their removal) to control the sharpness/smoothness of the resultant mesh.

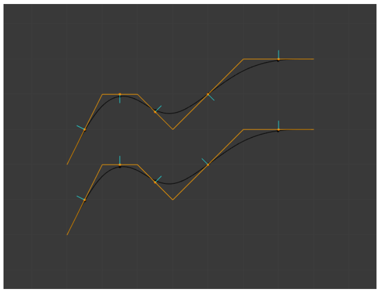
Known Limitations

Non-Contiguous Normals

Abrupt normal changes will prevent portions of the mesh from producing a smooth subdivision. Instead, these portions with non-contiguous normals will be subdivided using the “Simple” subdivision method.



Comparison of good normals and bad normals.

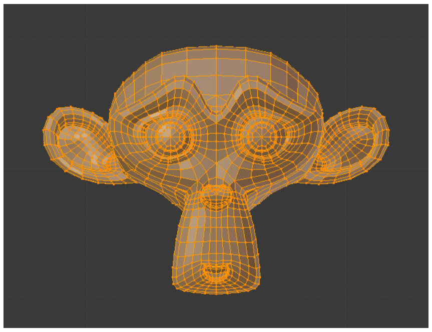


Side view of image on the left.

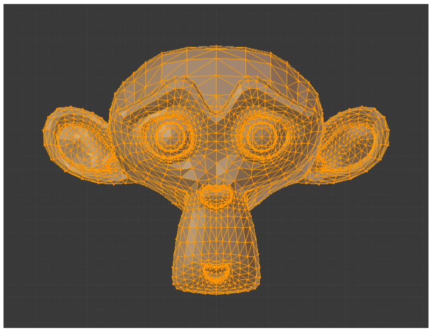
A quick way to fix this is to Recalculate Normals. If this does not work you may have to manually flip the normals.

Triangulate Modifier

The *Triangulate* modifier converts all faces in a mesh (quads and n-gons) to triangular faces. It fulfills the exact same function as the Triangulate tool in Edit Mode.

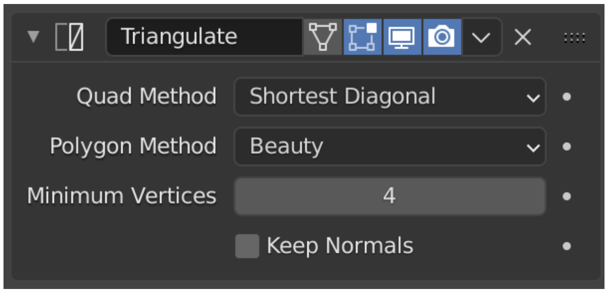


Mesh before Triangulate modifier.



Mesh after Triangulate modifier.

Options



Triangulate

Quad Method: Shortest Diagonal

Polygon Method: Beauty

Minimum Vertices: 4

☐ Keep Normals

The Triangulate modifier.

Quad Method

- Beauty
  - Split the quads in nice triangles, slower method.
- Fixed
  - Split the quads on their 1st and 3rd vertices.
- Fixed Alternate
  - Split the quads on their 2nd and 4th vertices.
- Shortest Diagonal